BIOPHYSICAL OVERVIEW, SIGNIFICANT, SENSITIVE AND DISTURBANCE FEATURES OF THE SADDLE HILLS, ALBERTA

Prepared for:

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EXECUTIVE SUMMARY

The Saddle Hills study area lies primarily within the Foothills Natural Region, with minor portions located within the Parkland Natural Region. The study area encompasses approximately 756 km^2. The city of Grande Prairie and the town of Sexsmith are located approximately 26 km and 8 km, respectively, south of the study area while the town of Spirit River is approximately 26 km to the north. Highway No. 2, running north - south, bisects the study area.

Increased resource development activity (petroleum exploration, agriculture, forestry, recreation etc.) in west-central Alberta and the resulting surface disturbances have put pressure on sensitive areas within the Saddle Hills. Geowest Environmental Consultants Ltd. was contracted in 1995 by Alberta Environmental Protection to conduct a biophysical land classification and range inventory, and to identify and map significant, sensitive, and disturbance features, in support of resource management initiatives within the Saddle Hills area.

Specific objectives of the project were:

- To conduct a biophysical inventory at the ecosite hierarchical level within the Saddle Hills study area at a scale of 1:20 000.
- To conduct an inventory of significant ecological features and sensitive features within the study area.
- To provide digitized ARC/INFO format biophysical maps and legends for the study area at a scale of 1:20 000.
- To provide digitized ARC/INFO format thematic maps of significant ecological features, disturbance features and sensitive features at a scale of 1:20 000.
- To collect range inventory data at each field site within the Saddle Hills study area.
- To provide a summary report according to specifications outlined in the Terms of Reference.

Thirteen different vegetation community types were identified, based on vegetative composition and landscape attributes which influence vegetation community development. The Aspen/prickly rose -low-bush cranberry/bluejoint community type is the most extensive in the area, with the Aspen/prickly rose-low-bush

cranberry/wild sarsaparilla and Aspen-balsam poplar/green alder/bluejoint communities also comprising a significant portion of the area.

The study area possesses relatively unique physical and topographic features. The Saddle Hills represent what was once a piedmont plain. This plain has gradually been altered by a combination of processes (pre-glacial erosion and glaciation) creating conditions that differ from the surrounding topography. A steep escarpment forms the northern extremity of the Saddle Hills.

Oil and gas activity is the primary industrial land use of the area. However, lower elevations of the Saddle Hills study area are also subject to extensive disturbance resulting from agricultural activities, including cultivation, fence lines, trails, farm residences and cattle watering facilities.

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1.0 INTRODUCTION

1.1 Location

The Saddle Hills study area is located in west-central Alberta, encompassing approximately 756 km^2 of predominantly native vegetation and undulating topography. The study area includes portions of Townships 74-76, Ranges 3-8, west of the Sixth Meridian (Figure 1). The city of Grande Prairie is located approximately 26 km south and the town of Spirit River about 26 km north of the study area. Highway No.2 runs north - south through the study area.

1.2 Purpose of Study

The purpose of this study, as commissioned by Alberta Environmental Protection, Edmonton, was to conduct a biophysical and range inventory, and identify significant, sensitive and disturbance features present in the Saddle Hills. The intent was to collect background information for use by government and industry in development of land management plans, and to identify areas where more detailed site-specific investigations may be necessary. The specific objectives were:

- To conduct a biophysical inventory at the ecosite hierarchical level within the Saddle Hills study area at a scale of 1:20 000;
- To conduct an inventory of significant ecological features and sensitive features within the study area;
- To collect range inventory data, as an aid in assessing the relative forage value of each plant community type;
- To provide digitized ARC/INFO format biophysical maps and legends for the study area;
- To provide digitized ARC/INFO format thematic maps of significant ecological, disturbance and sensitive features;
- To provide a summary report according to specifications outlined in the Terms of Reference.

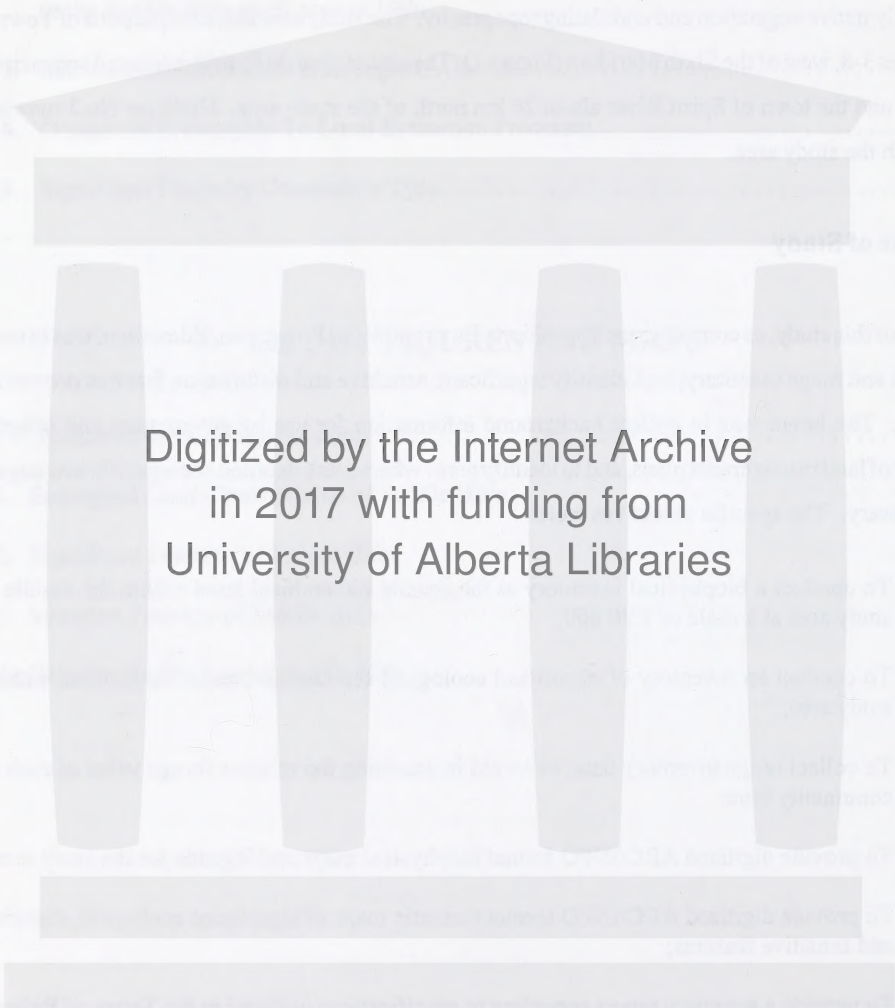
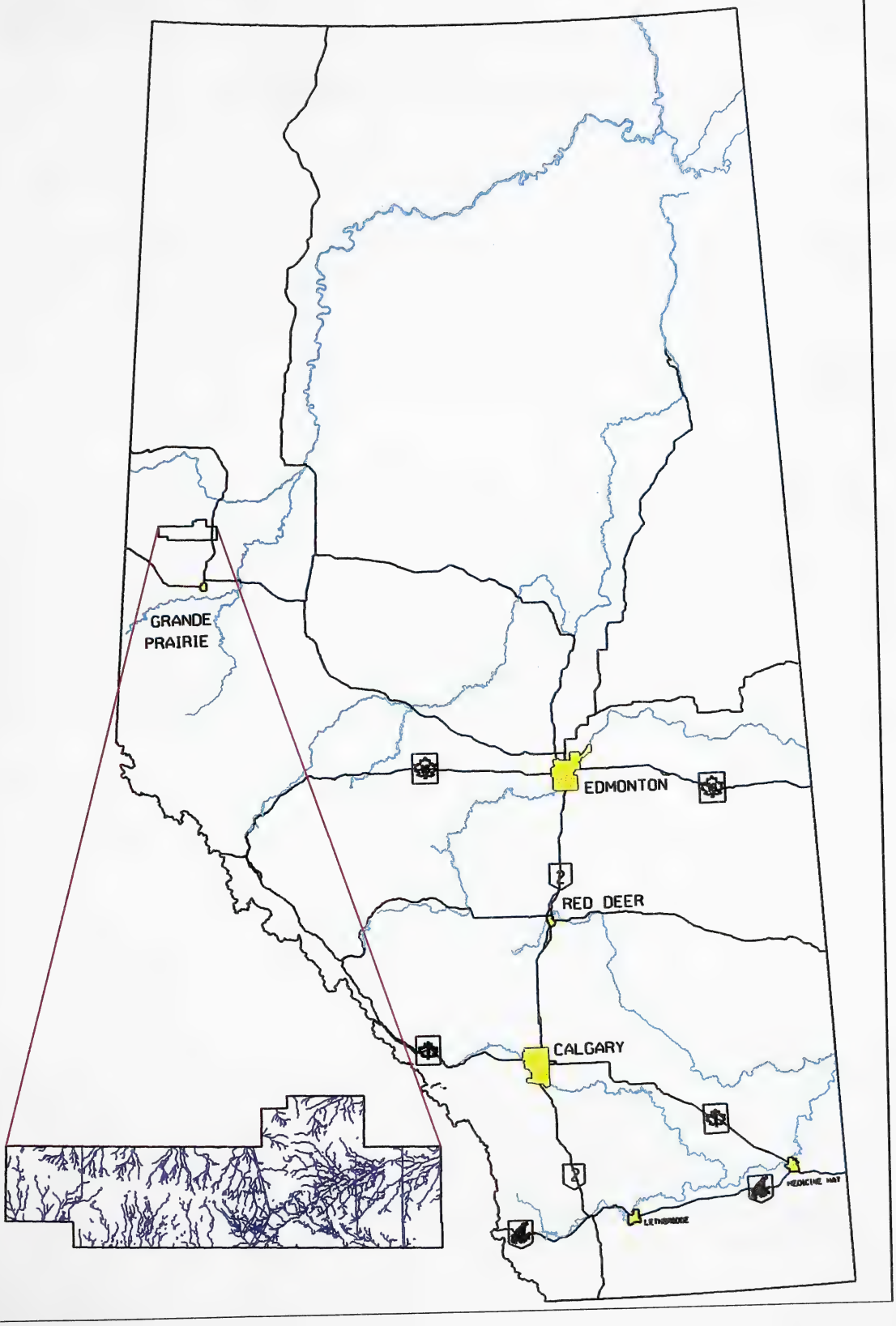


FIGURE 1: SADDLE HILLS STUDY AREA



2.0 STUDY AREA DESCRIPTION

2.1 Climate

The study area occurs primarily in the Lower Foothills Subregion of the Foothills Natural Region, with minor portions within the Peace River Parkland Subregion of the Parkland Natural Region (Achuff 1994). The climate is predominantly continental, with moderately warm summer and cold winter temperatures. In comparison with adjacent lower elevation Boreal subregions, however, the climate in the Lower Foothills Subregion is somewhat cooler in summer and warmer in winter (Achuff 1994), due to the moderating influence of the mountains to the southwest.

The nearest climate station is at the Beaverlodge Research Station, approximately 24 km west of the study area (Environment Canada 1993; Table 1). The annual precipitation at Beaverlodge is 467.5 mm, of which 66% (308.9 mm) falls as rain. By contrast, Edmonton and Grande Prairie have 465.8 mm and 450.2 mm of annual precipitation respectively. Of the mean annual precipitation at Beaverlodge, one half (241.5 mm) occurs during the growing season (May to August), with the greatest portion falling during June and July (139.2 mm). The average annual snowfall for this area is 187.2 cm with the greatest amount of snow falling from December to January (74.9 cm) (Environment Canada 1993).

Average annual temperature at Beaverlodge is 2.0°C. Edmonton and Grande Prairie, by contrast, have average annual temperatures of 2.1°C and 1.6°C respectively. July and August are the hottest months at Beaverlodge, with a mean temperature of 15°C between the two months and an average daily maximum temperature of 21.3°C. December and January are the coldest months with an average temperature of -12.7°C and an average daily minimum temperature of -17.3°C. Recorded extreme temperatures range from a maximum of 36.7°C to a minimum of -47.8°C.

Table 1. Summary of climate station data for the Saddle Hills study area.[1]

Station	Lat. N	Long. W	Elev. (m)	Anuual Precip. (mm)	Precip. May-Aug. (mm)	Degree Days Above 5°C (May-Aug)	Mean Daily Temp. May-Aug. (°C)	Mean Daily Temp. June-July (°C)
Beaverlodge CDA	55°'12	119° 24′	745	467.5	241.5	1007.7	13.1	14.3
White Mountain LO	55° 42′	119° 14′	1093	-	294.1	-	12.0	13.1
Fairview[2]	56° 04′	118° 23′	670	453.7	245.2	1105.7	13.9	15.3
Grande Prairie A[2]	55° 11′	118° 53′	666	450.2	239.2	1084.7	13.8	15.1
Edmonton Int'l A[2]	53° 18′	113° 35′	715	465.8	289.4	1096.0	13.9	15.1

[1] Canadian Climate Normals 1961 - 1990, Atmospheric Environment Service; Environment Canada 1993

[2] Included for comparison purposes

Prevailing winds are from the west to northwest, with available data suggesting an average wind speed of approximately 12 km/h. Total growing degree days for the area is 1244, with 1007.7 occurring from May to August. By contrast, Edmonton has 1567 total growing degree days while Grande Prairie has 1324 (Environment Canada 1993).

Long term observations from the first four climate stations listed in Table 1 indicate a fairly uniform regional climate. However, considerable variation can occur in yearly rainfall patterns. Local topography can also modify the local climate because of changes in elevation, slope and/or aspect. For example, the comparatively greater precipitation recorded at nearby White Mountain Lookout, to the northwest of the study area, is typical of hilly elevated areas in the region.

2.2 Physiography and Bedrock Geology

Topographic conditions of the Saddle Hills can be described as gently to moderately sloping, undulating and

locally hummocky. Elevations vary from a topographic high of approximately 991 masl (metres above sea level) to a topographic low of 564 masl in the Bad Heart River valley.

The Saddle Hills are the remnants of a former piedmont plain. This plain, consisting primarily of sandstone, was gradually eroded during pre-glacial times and later smoothed by glaciation.

Because of overlying glacial deposits of more recent origin, bedrock lies at or close to the surface only at scattered localities. The study area is underlain by a series of marine and non-marine sandstones, siltstones, and shales of Upper Cretaceous age. Dipping slightly towards the south, they become exposed along the steep escarpment that forms the northern extremity of the Saddle Hills. Two main formations occur, as described by Van Waas (1972). The Wapiti Formation, consisting of sandstone, siltstone, shale and coal, is the uppermost formation, covering the southern portion of the area. It is underlain by the Puskwaskau Formation, consisting of dark grey shales. This formation often results in the failures seen along the north escarpment. The Bad Heart Formation, consisting of shales, silty shale and iron-bearing sandstone, is limited to a narrow zone north of the Saddle Hills (TERA Environmental Consultants Ltd. 1993).

2.3 Surficial Geology

Surficial deposits of the study area are of both glacial and post-glacial origin (Odynsky *et al.* 1961). These deposits include till, glaciolacustrine, glaciofluvial, and more recent fluvial, colluvial, and organic deposits.

Laurentide ice sheets covered most of the area during the Pleistocene epoch. Glacial drift from this glaciation forms ablation and hummocky morainal veneer and blanket landforms. These till deposits tend to occur in topographically higher elevations of the Saddle Hills. Glaciolacustrine deposits, typically fine textured and non-stony, form remnant beach landforms. These are often found in lower areas, either as veneers or blankets over till (TERA Environmental Consultants Ltd. 1993).

Some surficial deposits show characteristics of more than one ice advance. An example of this occurs in the Braeburn area, close to the centre of the study area, where the parent material appears to be underlain by a much older till (Odynsky and Newton 1959). Three distinct glacial deposits can be found in this area. The first consists of a grayish-brown to brown sandy clay till that is somewhat stony, has numerous coal flecks

and is generally considered to be derived from the Wapiti Formation (Odynsky and Newton 1959). Glaciofluvial deposits, consisting of boulders, sands or gravels, are typically associated with this till deposit. The second deposit consists of a well-sorted, stratified till. This deposit, derived from the Smoky River shales (north of the study area), is a dark greyish-brown clay with few stones and numerous gypsum crystals (Odynsky *et al.* 1961). Van Waas (1972) described the third deposit as a shallow till over sandstone. This deposit is a yellowish brown, sandy, stony till with fragments of sandstone.

Both glaciofluvial and fluvial deposits occur adjacent to stream courses. Glaciofluvial deposits dominate the higher terraces, whereas more recent fluvial deposits are found on the lower terraces and floodplains. Peat and organic silt and clay infill poorly drained terrain depressions and recent lake basins forming organic bogs and fens. Colluvial slopewash, consisting of gravity-transported silt, sand and clay, with till inclusions, forms veneers and blankets on slopes in the area (TERA Environmental Consultants Ltd. 1993).

Odynsky and Newton (1959) noted a gravelly deposit in Section 7, Township 75, Range 5, W6M, different from other glacial deposits in this area. They conclude that it most resembles the Tertiary deposits capping the Cypress Hills in southeastern Alberta.

2.4 Soils

Soils belonging to the Luvisolic Order dominate the area. These soils generally have light-coloured, eluvial A horizons and illuvial B horizons in which silicate clay has accumulated. A Luvisolic B horizon must have the specified increase in clay over that in the eluvial horizon, clay skins indicative of translocated clay accounting for 1% or more of the area of a section through the horizon, and be at least 5 cm thick. Only soils from the Gray Luvisol Great Group were found within the study area. These soils usually have well-developed, platy Ae horizons of low chroma, Bt horizons with moderate to strong blocky structures, calcareous C horizons, and a sola of high base saturation. Gray Luvisols generally occur under mixed forest vegetation.

Soils belonging to the Brunisolic Order were also found in the study area. These soils have sufficient development to exclude them from the Regosolic Order, but they lack the degree of horizon development specified for soils of other orders. Brunisols under forest conditions generally have a brownish-coloured Bm

horizon at least 5 cm thick. Both the Eutric and Dystric Great Groups of the Brunisolic Order are found in the Saddle Hills. These Great Groups are separated on the basis of pH of the uppermost 25 cm of soil. Dystric Brunisols have a pH less than 5.5 in the uppermost 25 cm while Eutric Brunisols have a pH of 5.5 or greater in the uppermost 25 cm. The distribution of Eutric and Dystric Great Groups reflects the pH of the surficial materials which is in turn influenced by the underlying bedrock geology.

Soils of the Gleysolic Order were not commonly sampled in the Saddle Hills. These soils have features indicative of periodic or prolonged saturation by water, and the sites are typified by reducing conditions. Gleysols often occur in shallow depressions and on wet lowlands. They are usually associated with either a high groundwater table at some period of the year or temporary saturation above a relatively impermeable layer. Vegetation often differs from the surrounding soils due to the moisture content and poor internal drainage. Gleysols have either matrix colours of low chroma or distinct to prominent mottles of high chroma in the upper 50 cm. This suggests localized oxidation of ferrous iron and deposition of hydrated ferric oxides. Although these soils were not commonly sampled in the study area, it is probable that they dominate poorly drained sites.

Soils belonging to the Regosolic Order occur along stream valleys and on steeper slopes. These soils are "young" and lack well-developed profiles. This poor profile development may be due to a number of factors, including the youthfulness of the parent material (for example, recent alluvium), instability of the material (such as colluvium on slopes subject to mass wasting), the nature of the material (for example, dominated by quartz sand) and climate (cold environments).

Soils belonging to the Organic Order are infrequent in the study area. Organic soils are generally saturated with water for long periods and are derived from the vegetation that grows in these very poorly drained areas. Soils in this order must contain at least 30% organic matter by weight and are further differentiated based on the level of decomposition of the organic material. Only Mesisols, organic soils with partially decomposed organic materials, were described in the study area.

2.5 Vegetation

Most of the Saddle Hills study area occurs within the Lower Foothills Natural Subregion. Small portions

near the north and south boundaries are classed within the Peace River Parkland Natural Subregion (Achuff 1994). Over most of the study area, mixedwood forests that are typical of the Lower Foothills Natural Subregion predominate. These mixedwood forests consist of white spruce (*Picea glauca*), black spruce (*Picea mariana*), lodgepole pine (*Pinus contorta*), aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white birch (*Betula papyrifera*). The understory low shrub vegetation is variable although species such as prickly rose (*Rosa acicularis*), low-bush cranberry (*Viburnum edule*), willows (*Salix* spp.), and saskatoon (*Amelanchier alnifolia*) are common components. Common species in the forb and graminoid layers include wild sarsaparilla (*Aralia nudicaulis)*, cream-colored peavine (*Lathyrus ochroleucus*) and bluejoint (*Calamagrostis canadensis*).

Portions of the Saddle Hills study area, primarily near the northeastern and southeastern boundaries, are included within the Peace River Parkland Natural Subregion. The upland forests of the Peace River Parkland Subregion are dominated by aspen and white spruce with no lodgepole pine, and lesser amounts of balsam poplar on wetter sites. Understory vegetation is typically dominated by green alder (*Alnus crispa*), prickly rose, low-bush cranberry, red-osier dogwood (*Cornus stolonifera*), bunchberry and wild sarsaparilla (*Aralia nudicaulis*). Grasslands occurring on steep, south facing valley slopes are dominated by wheat grass (*Agropyron* spp.)- sedge (*Carex* spp.) communities. These grasslands are noted for supporting disjunct species, often those with a more southerly or westerly distribution (Achuff 1994).

Imperfectly drained sites are typically dominated by a mixture of aspen and balsam poplar, while poorly drained sites with good aeration develop balsam poplar stands. Other poorly drained sites commonly exhibit a black spruce - tamarack (*Larix laricina*) overstory with an understory of common Labrador tea (*Ledum groenlandicum*), bog cranberry (*Vaccinium vitis-idaea*), and mosses. Tree growth on these sites is slow because of poor nutrient status, high water table and lack of aeration, and low soil temperature (Strong 1992).

The actual community and species representation at any given site will be influenced by numerous factors including slope and aspect, moisture regime, soil properties, and disturbance type and intensity. Detailed discussion of the vegetation of the study area is presented in Section 4.2.

2.6 Wildlife

Because of the heterogeneous nature of the vegetation communities within the Saddle Hills, a broad complement of wildlife species is supported. Based on provincial ranges described for mammals (Smith 1993), birds (Semenchuk 1992), herpetiles (Russell and Bauer 1993), and fish (Nelson and Paetz 1992), the Saddle Hills study area is anticipated to include an assemblage of at least 47 mammal species, 73 bird species, 3 amphibian species, and 15 fish species.

The list of faunal species anticipated to occur in the Saddle Hills includes several significant species which are considered to be at risk in Canada or within the province. One mammal species, the wolverine (*Gulo gulo*), has been designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as nationally 'vulnerable' (a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events; COSEWIC 1998). On a provincial scale, 3 mammal species and one bird species are blue-listed, and 4 mammal and 8 bird species are yellow-listed (Alberta Environmental Protection 1996). A detailed discussion of the significant fauna that occur in the Saddle Hills study area is presented below in Section 4.4.

Some species are at the limits of their Alberta range in the Saddle Hills or have isolated or disjunct populations in the study area. Examples of such species in the Saddle Hills include the arctic shrew (*Sorex arcticus*), usually found at low elevations in the province, and the long-legged bat (*Myotis volans*), which generally occurs in the mountains and foothills but may range into higher elevation portions of the Saddle Hills.

Also of primary significance in the study area are several large game species and furbearing animals of extreme economical, ecological, and aesthetic value. Approximately 800 - 1,000 elk, or wapiti, (*Cervus canadensis*) are estimated to winter in the Saddle Hills / Spirit Ridge area (D. Hervieux, Alberta Environ. Prot., Grande Prairie, personal communication). Moose (*Alces alces*) are also abundant in the Saddle Hills, with mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), gray wolf (*Canis lupus*), and black bear (*Ursus americanus*) all present as well. Trapping records from Alberta Environmental Protection also confirm the presence of pine marten (*Martes americana*), fisher (*Martes pennanti*), mink (*Mustela vison*), and lynx (*Lynx canadensis*) in the study area (Alberta Fish and Wildlife Division, 1996

unpubl. data).

Mammal use of forested habitats in the Saddle Hills area is closely related to stand age and, thus, stand structure. Species that require dead trees (snags) for nesting and/or foraging (for example, woodpeckers, pine marten, and red squirrel) or which nest or feed in the canopy, are commonly found in old stands where canopy height and snag density are highest. On the other hand, species that forage on shrubs or saplings (such as snowshoe hare and moose) are generally more common in young stands where the density of shrubs and saplings is highest.

A diverse assemblage of breeding bird communities is found in the Saddle Hills, due to the heterogenous nature of the boreal mixedwood forests. Forest-interior species such as pileated woodpecker (*Dryocopus pileatus*) and ovenbird (*Seiurus aurocapillus*) occupy tracts of mature and old growth deciduous and mixedwood forests. Edge-adapted birds such as warbling vireo (*Vireo gilvus*) and common yellowthroat (*Geothlypis trichas*) inhabit natural forest openings such as wetland margins.

On a regional basis, the Saddle Hills area is rated as Class 7, the lowest category, by the Canada Land Inventory (CLI) for waterfowl production capability (CLI 1971). Some production of waterfowl, including both diving and dabbling ducks occurs on larger lakes such as Hilltop Lake. Numerous wetlands provide seasonal habitats for migrating waterfowl. Green-winged teal (*Anas crecca*), blue-winged teal (*Anas discors*), northern pintail (*Anas acuta*), and Canada goose (*Branta canadensis*) are some of the more common species in the area.

Warm-water fish species capable of surviving in shallow turbid waters likely predominate the fish assemblage of the Saddle Hills. Based on species ranges described by Nelson and Paetz (1992), these likely include chubs (*Platygobio gracilis* and *Couesius plumbeus*), shiners (*Richardsonius balteatus* and *Notropis hudsonius*), and suckers (*Catostomus* spp.). Brook stickleback (*Culaea inconstans*) may be the most common fish species, due to its affinities to small, shallow bogs and beaver ponds. This species has a high tolerance to conditions of low oxygen and often occurs in areas where other fish could not survive.

3.0 METHODS

3.1 Ecological Land Classification Methods

Ecological Land Classification (ELC) is a hierarchical landscape mapping system in which the land surface is subdivided and classified into areas of similar environments. The map units are characterized by recurring patterns of surficial materials, landform, soil and vegetation.

The primary method used to derive ecological units is aerial photo interpretation. The land surface is divided into units according to factors such as slope, landform, drainage, parent materials and vegetation. After background data compilation and the initial interpretation, field checks are carried out to verify descriptions of the map units and to compile more detailed site, soil and vegetation information.

Field sampling for detailed site and vegetation description was conducted from August 22 to August 30, 1995, according to methods outlined in the Ecological Land Survey Site Description Manual (Alberta Environmental Protection 1994). Initially, potential field sample sites were selected by using aerial photographs. Site locations were chosen to document the range of environmental conditions throughout the area. At each site, information was collected on soils, parent materials, vegetation composition and site characteristics, using standard field plot forms. Wildlife observations were also recorded. In total, 100 detailed plots were established.

Plant taxonomy follows Moss (1983) with common names conforming to the Alberta Vegetation Species List (Alberta Environmental Protection 1993). Latin and common names of all plant species mentioned in this report are given in Appendix 2. Photographs were also taken at each site to illustrate physiographic and physiognomic characteristics.

To classify and map ELC units, the landscape is generally divided into a four tiered hierarchical system based on dominant landscape characteristics - Natural Region and Subregion, Ecodistrict, Ecosection and Ecosite. The basic unit used for mapping in this study was the ecosite level at a mapping scale of 1:20,000. Final cartography was also completed at a scale of 1:20,000. The higher levels of classification were considered

in the initial interpretation but omitted from the final mapping.

Each ecosite unit was given a descriptive map unit symbol or code. For example, for the ecosite symbol GL1, GL describes the primary landform or parent material, in this case glaciolacustrine, while the following numeric character, 1, describes a subdivision based on soil, vegetation or physiographic features. Further description of the mapping codes used is given in Section 4.1 and on the Map 1 legend.

Map units (ecosites) are described in detail in the legend accompanying the Ecological Land Classification map. Ecosites are arranged alphabetically in the legend according to the surficial material code that forms the first part of the map symbol. Biophysical features included in the legend are as follows: landform and surficial materials, vegetation, soil classification, slope (%), soil drainage, surface soil texture, subsurface soil texture, soil permeability, depth (cm) to bedrock, other impermeable layers or water table, surface rockiness class, surface stoniness class, shrink-swell potential, potential frost action and flood hazard.

Vegetation community types in the study area were identified using aerial photograph interpretation and field data collection. Some community types identified were not intensively sampled in the field.

3.2 Biomass Data Collection

To assess relative forage value of vegetation community types, biomass data were collected, from July 23 to 29, 1996. Guidelines outlined in the Ecological Land Survey Site Description Manual (Alberta Environmental Protection 1994), were generally followed, with the exception of microplot size. At each of the 100 survey sites documented in 1995, one circular microplot 1 m in diameter (0.785 m^2) was established in an area representative of the community type. All live graminoids, forbs and low-growing shrubs within the microplot were clipped to ground level, in order to determine annual forage productivity. The clipping was carried out in mid-summer, as close as possible to the time when vegetation had reached its peak production. Graminoids, forbs and low-growing shrubs were each bagged separately. The bags were air-dried and weighed. The data from all sites were then grouped according to vegetation community type, and average annual production within each community type calculated in kg/ha for each layer.

3.3 Identification of Significant Features

The identification and mapping of significant features, particularly of rare flora and fauna, relied heavily on review of existing information and on extrapolation from studies in adjacent areas. Detailed field study will be required in many cases to confirm the occurrence of significant flora and fauna specifically within the study area.

Environmentally significant areas (ESAs) are areas deemed to be important for maintaining ecological processes, and are also often sensitive to disturbance. The significance of sites within the Saddle Hills study area was based on a consideration of 14 criteria adapted from Eagles (1984), including:

- areas which perform a vital environmental, ecological or hydrological function such as aquifer recharge
- areas which contain rare or unique geological or physiographic features
- areas which contain significant, rare or endangered plant or animal species
- areas which are unique habitats with limited representation in the region or are a small remnant of once large habitats which have virtually disappeared
- areas which contain an unusual diversity of plant and/or animal communities due to a variety of geomorphological features and microclimatic effects
- areas which contain large and relatively undisturbed habitats and provide sheltered habitat or species which are intolerant of human disturbance
- areas which provide an important linking function and permit the movement of wildlife over considerable distances, including migration corridors and migratory stopover points
- areas which contain plants, animals or landforms which are unusual or are of local, regional, provincial, national or international significance
- areas that are excellent representatives of one or more ecosystems, habitats or landscapes
- areas with intrinsic appeal due to widespread community interest or the presence of highly valued features or wildlife species valued for hunting
- areas with lengthy histories of scientific research

- areas containing specific old-growth values or older forest stands
- areas which perform a vital function for wildlife in the area
- areas with cultural, historical or archaeological significance.

The significance of each site was categorized according to Eagles (1984) as follows:

International - features which are unique in the world

National - features which are limited in distribution at a national level or which are the best or only representatives in Canada

Provincial - features which are of limited distribution or are the best examples of a feature in the province

Regional - features which are of limited distribution or are the best examples of a feature in the region

Local - features which are of limited distribution or are the best examples of a feature in the study area.

For the purposes of this report, wildlife species will be considered significant if they have:

- ✦ been designated as such by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1998);
- ✦ been included on the red-, blue-, or yellow-lists of species of concern within the province of Alberta (Alberta Environ. Prot. 1996);
- ✦ been cited as being locally rare or uncommon in the province; or
- ✦ been cited as being of relatively high abundance in the Saddle Hills region.

COSEWIC determines the national status of species, sub-species, and separate populations of native fish, amphibians, reptiles, birds, and mammals in Canada. COSEWIC has identified five risk categories for Canadian wildlife species, as follows (COSEWIC 1998):

Extinct - a species that no longer exists anywhere

Extirpated - a species no longer existing in the wild in Canada but occurring elsewhere

Endangered - a species facing imminent extinction or extirpation

Threatened - a species likely to become endangered if limiting factors are not reversed

Vulnerable - a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Provincial populations of wildlife species in Alberta have also been evaluated, and their status classified based on the following categories (Alberta Environmental Protection 1996):

Red - species whose populations are nonviable or at immediate risk of declining to non-viable levels in Alberta. They have, or will be considered for, designation as Endangered Species in Alberta.

Blue - species which are also at risk but the threats that they face are less immediate. Particularly vulnerable to non-cyclical declines in population or habitat degradation.

Yellow - sensitive species which are not currently believed to be at risk. They may require special management to address concerns related to low natural populations, limited provincial distribution, or particular biological characteristics.

Subdivided into Yellow A and Yellow B categories:

Yellow A - species which merit extra attention because they have experienced long-term declines in numbers.

Yellow B - species naturally rare, with clumped distributions or associated with deteriorating or threatened habitats.

Green - species not considered to be at risk. Their populations are healthy and often widespread and key habitats are generally secure.

For this report, significant flora are defined as those plant species which have been recognized as rare in Alberta (with 5 or fewer collections) by Packer and Bradley (1984). Wallis et at (1987) and Argus and Pryor (1990) provided further information on the status of rare plants.

A map showing significant areas in the Saddle Hills was created at a scale of 1:20 000.

3.4 Identification of Sensitive Features

Soils and landscape information collected during the course of detailed and reconnaissance surveys were used to assist in subsequent mapping of sensitive features. Parameters considered included soil type and texture, slope, topography, parent material and vegetation composition, among others. Sensitive features in the study area are shown at a scale of 1: 20,000.

3.5 Identification of Disturbance Features

Disturbance features as determined by aerial photograph interpretation and background information were confirmed during the course of field studies. A map showing existing disturbance features was produced, at a scale of 1: 20,000.

3.6 Polygon Database Preparation

A digital database was prepared which incorporated the key characteristics of each map polygon shown on Map 1, the Ecological Land Classification. The database was formatted in dBASE IV and was structured to be easily incorporated with spatial data files for future GIS analysis and presentation if required. As specified in the study Terms of Reference, the following fields were included in the database:

Dominant landscape parameters:

polygon number
ecosite
parent material
surficial expression
proportion of polygon
soil classification to subgroup level
slope class
drainage class
surface soil texture
subsurface soil texture
vegetation community type(s)
soil permeability class
depth to bedrock (cm)
depth to impermeable layer (cm)

depth to water table (cm)
surface rockiness class
surface stoniness class
shrink-swell potential class
potential frost action class
flood hazard class

Subdominant landscape parameters:

parent material
surface expression
proportion of polygon
soil classification to subgroup level
slope class
drainage class
surface soil texture
subsurface soil texture
vegetation community type(s)

Database codes follow the Canadian System of Soil Classification (Canada Soil Survey Committee 1987) for the following parameters:

- parent material
- surface expression
- slope classes
- soil drainage classes
- soil subgroup classification
- soil texture

Vegetation community type codes, potential frost action classes, surface rockiness classes and surface stoniness classes are defined in Appendices 1, 3, 4 and 5 respectively.

4.0 RESULTS

4.1 Ecological Land Classification

The Ecological Land Classification of the study area is presented on Map 1 and the accompanying legend. The following is a key to the surficial materials present in the Saddle Hills study area:

F	Fluvial
FO	Fluvial and Organic complexes
GF	Glaciofluvial
GL	Glaciolacustrine
L	Lacustrine
MGL	Moraine and Glaciolacustrine complex
M	Moraine
MC	Moraine and Colluvium complex
MO	Moraine and Organic complex
O	Organic

4.2 Description of Vegetation Community Types

Vegetation community development is influenced by annual temperature and precipitation regimes, as well as microsite variability in aspect, slope, moisture regime, salinity and other soil properties, and disturbance factors. In total, thirteen community types were identified within the study area. They are:

1. Aspen/prickly rose-low-bush cranberry/bluejoint
2. Aspen/prickly rose-low-bush cranberry/wild sarsaparilla
3. Aspen/prickly rose-snowberry/awnless brome-bluejoint
4. Aspen/Canada buffaloberry/bunchberry
5. Aspen-balsam poplar/green alder/bluejoint
6. Aspen-balsam poplar/red-osier dogwood-prickly rose
7. White spruce/bunchberry/feathermoss
8. Lodgepole pine-white spruce/common Labrador Tea/feathermoss
9. Lodgepole pine/green alder/bunchberry

10. Black spruce-tamarack/common Labrador tea/Sphagnum moss

11. Bluejoint - beaked sedge / buck-bean

12. Miscellaneous Wetland Communities

13. Upland Shrubland

(1) Aspen/prickly rose-low-bush cranberry/bluejoint:

This is a mature to old seral community type characteristic of well to imperfectly drained, level to undulating midslope positions. Parent materials vary from coarse to fine textured, slightly to moderately stony morainal deposits to medium textured, non-stony glaciolacustrine deposits. Open stands of mature to overmature, lightly stocked aspen dominate the upper canopy of this community. Lesser amounts of balsam poplar also occur. Other minor tree species include white spruce, lodgepole pine and white birch, although white birch seldom reaches a height greater than 5 metres. Succession is to white spruce in the absence of disturbance.

Stand history affects structure and composition of this community. O'Leary and Downing (1986) suggested that the proportions of aspen and balsam poplar may change because of differing mortality. Aspen usually have a shorter life span than do balsam poplar, 120 years compared to 135 years. Without a nearby seed source, white spruce regeneration is extremely slow, and consequently with increasing age and mortality the canopy opens. This then allows shade-intolerant understory species such as fireweed and bluejoint to flourish (O'Leary and Downing 1986).

The tall shrub layer is dominated by willow (primarily *Salix bebbiana* and *Salix glauca*) and green alder, with prickly rose, low-bush cranberry and dewberry (*Rubus pubescens*) predominant in the low shrub layer. The forb layer is usually not as diverse as the shrub layer. Common fireweed (*Epilobium angustifolium*) is the only forb species that consistently occurs with high cover. Other common forbs include showy aster (*Aster conspicuus*), and pink wintergreen (*Pyrola asarifolia*). The graminoid layer is highly variable, with bluejoint being the only species typically occurring with greater than 10 percent cover. Moss and lichen cover is commonly low with stair-step moss (*Hylocomium splendens*) and studded leather lichen (*Peltigera aphthosa*) being the most common species.

(2) Aspen/prickly rose-low-bush cranberry/wild sarsaparilla:

The successional status of this plant community varies within the study area from young seral to mature seral. It occurs on level to moderately sloping morainal and glaciolacustrine materials that are typically fine-textured, although sites with coarse-textured materials are also found. Soils of this association vary, depending on drainage. The most common soils are Dark Gray and Orthic Gray Luvisols developed on moderately well to imperfectly drained sites. The moderately well-drained positions are dominated by Orthic and Eluviated Eutric Brunisiols while Gleysols (Rego Humic and Humic Luvic) generally occur on imperfectly to poorly drained sites. Other soils include Solonetzic and Brunisolic Gray Luvisols.

The canopy of this community is usually dominated by heavily stocked aspen. In some situations, however, balsam poplar is either dominant or co-dominant depending on stand age. Site-specific soil conditions including imperfect to poor drainage also favour balsam poplar growth. White spruce, lodgepole pine and white birch are the other minor tree species of the canopy. Regeneration of the above species is variable and dependent on site characteristics. This community is generally of fire origin and should eventually succeed to white spruce if a seed source is available.

The tall shrub layer of this community is not well developed. Combined cover over ten percent is rare, occurring only when there are significant breaks in the canopy. Various willows (*Salix* spp.), green alder and saskatoon tend to be associated with most sites. Prickly rose and low-bush cranberry dominate the low shrub layer.

A close relationship exists between this community and the Aspen/prickly rose - low-bush cranberry/bluejoint community type. The two communities differ in that the forb and graminoid layers of the Aspen/prickly rose - low-bush cranberry/wild sarsaparilla community usually show greater diversity. Common species include wild sarsaparilla, showy aster (*Aster conspicuus*), common fireweed and bluejoint. As the stand ages, however, and the aspen start to become decadent, bluejoint and common fireweed can be expected to increase dramatically. Thus, without a nearby seed source, the Aspen/prickly rose - low-bush cranberry/wild sarsaprilla association develops into the Aspen/prickly rose-low-bush cranberry/bluejoint association.

(3) Aspen/prickly rose-snowberry/awnless brome-bluejoint:

This is the characteristic very young seral vegetation community type found on well to moderately well drained, level to moderately inclined slopes. It is associated with drier aspects and is commonly located adjacent to water courses throughout the area. Parent materials are primarily fluvial or glaciofluvial, although morainal sites do exist.

Two different phases of this community exist within the study area. A prickly rose-snowberry/awnless brome- bluejoint phase exists in areas that are frequently disturbed, such as those affected by periodic floods and fires. This phase has very little aspen cover, about 1% and only in the tall shrub layer. In areas not recently disturbed, aspen cover increases dramatically (up to 45%) to form the Aspen/prickly rose-snowberry/awnless brome-bluejoint association. Lodgepole pine is also found in the tall shrub layer, but regeneration is primarily aspen.

The tall shrub layer is poorly developed with beaked willow (*Salix bebbiana*) being the only true tall shrub common on these sites. Prickly rose and snowberry (*Symphoricarpos albus*) dominate the low shrub layer of this community, but wild red raspberry (*Rubus idaeus*) and saskatoon are also common. The forb layer is highly variable and closely related to the density of aspen cover. As aspen cover increases, forb cover decreases. Common forbs include northern bedstraw (*Galium boreale*), wild vetch (*Vicia americana*) and common yarrow (*Achillea millefolium*). Awnless brome (*Bromus inermis*) and bluejoint typically dominate the graminoid layer, with 15 to 96% cover.

Both disturbance and edaphic conditions affect the development of this association. Periodic flooding and burning combined with rapid runoff and high evapotranspiration rates form conditions favourable for grassland vegetation. If disturbance is removed, aspen suckers are allowed to encroach, eventually forming a tree canopy. This reduces evapotranspiration causing grassland species to be out-competed and aspen to dominate.

(4) Aspen/Canada buffaloberry/bunchberry:

This vegetation type occurs on well to moderately well drained morainal landforms throughout the study area. Topography varies from level to undulating. Soils are predominately Orthic Gray Luvisols with minor occurrences of Solonetzic and Dark Gray Luvisols. Aspen generally dominates a tree layer that includes lesser amounts of balsam poplar and white spruce. Amount of white spruce, the climax tree species, varies from site to site.

The shrub layer is generally diverse and well developed, with the most common species being Canada buffaloberry (*Shepherdia canadensis*), prickly rose, low-bush cranberry, white meadowsweet (*Spiraea betulifolia*), snowberry, bunchberry and dewberry. White meadowsweet generally increases with grazing intensity. Herbaceous vegetation is also diverse, although cover is variable depending on overstory density. Characteristic forbs include wild sarsaparilla, twinflower (*Linnaea borealis*), and wild lily-of-the-valley (*Maianthemum canadense*). Grass cover is variable with bluejoint and hairy wild rye (*Elymus innovatus*) being most common. Feathermoss cover is usually quite sparse.

(5) Aspen-balsam poplar/green alder/bluejoint:

This is a mature to old seral community type characteristic of moderately well to imperfectly drained, level to undulating upland positions. Parent materials consist of coarse to fine textured, slightly to moderately stony morainal deposits as well as coarse-textured, non-stony glaciolacustrine deposits. Orthic Gray Luvisols are the dominant soil type. Other soils include Orthic Dystric Brunisols, Humic Luvic Gleysols and Brunisolic and Dark Gray Luvisols. Aspen and balsam poplar co-dominate throughout these stands. Other tree species present in the canopy layer include white spruce, lodgepole pine and white birch. This community should eventually succeed to white spruce.

Green alder is prevalent in the tall shrub layer, with cover values ranging up to 75%. Other tall shrubs present include beaked willow (*Salix bebbiana*) and pussy willow (*Salix discolor*). The low shrub layer is dominated by bracted honeysuckle (*Lonicera involucrata*) with lesser occurrences of prickly rose, wild red raspberry (*Rubus idaeus)*, low-bush cranberry and bristly black currant (*Ribes lacustre*). Wild sarsaparilla and common fireweed are the most common species in a relatively diverse forb stratum. Grass cover is

highly variable and tends to be affected by grazing intensity. Lightly grazed sites have a well developed graminoid layer consisting primarily of bluejoint. As grazing intensity increases, bluejoint cover decreases. The moss layer is absent at most sites, although stair-step moss (*Hylocomium splendens)* occurs infrequently. Reindeer lichen (*Cladina mitis*) and studded leather lichen (*Peltigera aphthosa*) can occasionally be found in minor amounts.

(6) Aspen-balsam poplar/red-osier dogwood-prickly rose:

This young to mature seral community type is found on moderately well to poorly drained undulating to inclined mid-slope terrain consisting of fine-textured morainal, glaciofluvial and glaciolacustrine materials. It can be described as having well-stocked stands of aspen and balsam poplar in the tree stratum.

In the shrub layer, prickly rose is dominant, with low-bush cranberry and red-osier dogwood as important associates. White spruce is an occasional species in the shrub layer, occurring in 29% of sampled sites. Common fireweed and tall lungwort (*Mertensia paniculata*) are generally present in greater abundance than other forb species. The graminoid layer, dominated by bluejoint, is variable in cover, occupying from 3 to 30% of the ground surface. The moss and lichen layer of this community is generally sparse.

(7) White spruce/bunchberry/feathermoss:

This climax community type is found on moderately well to imperfectly drained, fine textured soils developed on inclined to undulating morainal materials. Soils include Brunisolic and Orthic Gray Luvisols. This community type has a well-developed vertical structure. The tree layer is dominated by mature white spruce, often up to 25 metres in height. Lesser amounts of aspen, balsam poplar, black spruce and lodgepole pine also occur.

Common species include low-bush cranberry, common Labrador tea, prickly rose, Canada buffaloberry, bracted honeysuckle, bunchberry, bishop's-cap (*Mitella nuda*) and twinflower. Feathermosses, including stair-step moss (*Hylocomium splendens*), Schreber's moss (*Pleurozium schreberi*) and knight's plume moss (*Ptilium crista-castrensis*) often comprise a significant portion of the ground cover. Studded leather lichen (*Peltigera aphthosa*) is also common.

(8) Lodgepole pine-white spruce/common Labrador tea/feathermoss:

This is a young to mature seral community type found on well-drained, level to gently undulating fine textured deposits. Sites typically occur on glaciolacustrine veneers and blankets over moraine and often occupy transitional lower to mid-slope sites between well-drained uplands and poorly drained organics. Soils are predominately Brunisolic Gray Luvisols and are usually classified as submesotrophic (somewhat deficient in nutrients). The overstory is generally dominated by lodgepole pine, and to a lesser degree white spruce. White spruce is usually more prevalent in the lower canopy because of its slower growth rate. Minor occurrences of other tree species such as black spruce, tamarack, aspen and balsam poplar also occur.

The shrub layer is dominated by common Labrador tea. Additional shrub cover is provided by prickly rose, beaked willow (*Salix bebbiana*), bracted honeysuckle, Canada buffaloberry, bunchberry, bog cranberry (*Vaccinium vitis-idaea*), and dwarf bilberry (*Vaccinium caespitosum*). The herb layer is generally poorly developed with low species diversity. Common species include twinflower and palmate-leaved coltsfoot (*Petasites palmatus*). Sedges (*Carex* spp.) dominate the graminoid layer while feathermosses generally form a continuous carpet on the forest floor.

(9) Lodgepole pine/green alder/bunchberry:

This is a young seral vegetation community type found on moderately well drained, undulating morainal materials. Soils are dominated by fine textured Orthic Gray Luvisols. The most common overstory species is lodgepole pine, generally greater than 20 m in height. Other associated tree species include aspen and balsam poplar.

The dominant component of the shrub layer is green alder. Other common shrub species include prickly rose, low-bush cranberry, bracted honeysuckle and white meadowsweet. Bunchberry is also relatively high in cover. Common forbs include common fireweed, stiff club-moss (*Lycopodium annotinum*) and wild sarsaparilla. Grass cover is moderate, with bluejoint the dominant species. Feathermoss cover is generally patchy and discontinuous, and the most common species are Schreber's moss and knight's plume moss.

(10) Black spruce-tamarack/common Labrador tea/ sphagnum moss:

This maturing edaphic climax community is found sporadically throughout the study area, generally occurring on poorly to very poorly drained organic deposits overlying morainal clays. These are typically ombrogenous peatland types, receiving water primarily from atmospheric precipitation, and as a result are mineral-poor. Black spruce is usually dominant in the tree layer but may be quite stunted and patchy in growth form. Tamarack may also be present as a minor overstorey component. Common Labrador tea is usually extensive in the shrub layer, often with basket willow (*Salix petiolaris*), and bog birch (*Betula glandulosa*). Palmate-leaved coltsfoot (*Petasities palmatus*), large northern aster (*Aster modestus*) and various sedges (*Carex* spp.) are generally the most common associated forbs and graminoids. Although *Sphagnum* mosses are prevalent, other moss species including Schreber's moss also occur.

(11) Bluejoint - beaked sedge/ buck-bean:

This community is common in frequently flooded lake basins and in mineral-rich peatlands generally referred to as fens. This association is less common in the study area than the Black spruce-tamarack/common Labrador tea/Sphagnum moss bog community. Vegetation is graminoid-dominated, with beaked sedge (*Carex rostrata*) and bluejoint the prevalent species. Forb species include buck-bean (*Menyanthes trifoliata*), marsh cinquefoil (*Potentilla palustris*), water arum (*Calla palustris*) and water-parsnip (*Sium suave*). Occasionally, low tree and shrub species occur, including white birch and pussy willow (*Salix discolor*).

(12) Miscellaneous Wetland Communities

There are numerous other minor community types within the Saddle Hills that were not field checked, and instead were identified by either aerial photography or reconnaissance plots. Miscellaneous wetland communities include sedge fen, cattail-sedge, and bog birch-willow/sedge/moss communities.

The sedge fen and cattail associations are common around the margins of frequently flooded lake basins and small wetlands with year-round high water tables. These communities are characterized by an extensive cover of graminoid species such as water sedge (*Carex aquatilis*), awned sedge (*Carex atherodes*) and bluejoint, interspersed with clumps of cattail (*Typha latifolia*) and bulrush (*Scirpus spp.*). Floating, sedge-

dominated vegetation mats and small islands of floating vegetation commonly occur in the shallower, open-water portions of small water bodies in the study area. Common associated forb species include water arum (*Calla palustris*), buck-bean and water hemlock (*Cicuta maculata*).

The bog birch-willow/sedge/moss community often occurs in geogenous, minerotrophic peatlands generally referred to as fens, or in conjunction with black spruce-dominated bogs. The tree component of the bog birch-willow/sedge/moss community is sparse and is generally dominated by stunted tamarack with occurrences of black spruce. The shrub layer is not very diverse with the most common species being bog birch (*Betula glandulosa*), and willows (*Salix* spp.). Bryophytes of these communities are primarily brown mosses such as *Aulacomnium palustre, Tomenthypnum nitens, Drepanocladus* spp. and *Plagiomnium* spp., with patches of *Sphagnum* spp.

(13) Upland Shrubland

A Willow-alder shrubland community is found along the northern escarpment of the Saddle Hills. It is typically found on sites that have recently slumped, and many still show some signs of movement. A second shrubland type, a Snowberry-saskatoon community, occurs on south-facing slopes, such as along the Bad Heart River. This community has a wide diversity of forbs, including wild vetch (*Vicia americana)*, northern bedstraw (*Galium boreale)*, wild strawberry (*Fragaria virginiana*) and harebell (*Campanula rotundifolia)*. The graminoid layer is dominated by slender wheat grass (*Agropyron trachycaulum)* and smooth brome.

4.3 Forage Productivity

The average 1996 productivity values for Saddle Hills vegetation community types are presented in Table 2. Total biomass (sum of dry weights of above-ground parts of grasses, forbs and low-growing shrubs) produced in Saddle Hills vegetation community types in 1996 varied from 90 to 2134 kg/ha (Table 2). Graminoid biomass ranged from almost nil in the White spruce / bunchberry / feathermoss community type to an average of over 2099 kg/ha in the Bluejoint-beaked sedge/buck-bean type. Appendix 6 gives dry weights of individual samples at each site.

The Bluejoint - beaked sedge / buck-bean community type produced the greatest biomass, nearly all of which

consisted of grasses and sedges (Table 2). Stands of this type occur primarily in frequently flooded areas and in fens. Cattle access to these areas may be limited by the high water table, especially in periods of high precipitation.

The lowest biomass values occurred in two of the coniferous community types (#7 White spruce/bunchberry/feathermoss and #8 Lodgepole pine - white spruce/common Labrador tea/feathermoss).

In these mature seral to climax forests, shading of the forest floor by the closed canopy of mature trees minimized productivity of the forb and graminoid layers. The understory of these communities was dominated by a continuous carpet of feathermosses, sometimes associated with ericaceous shrubs.

Average 1996 production in the most extensive community type in the study area, the Aspen/prickly rose - low-bush cranberry/bluejoint type, totalled 746 kg/ha. The majority of the clipped biomass from this community was represented by forbs (51%), with 13% graminoids and 36% low-growing shrubs (Table 2). Although bluejoint occurred consistently in this community type, it was often secondary in cover to common fireweed.

We clipped all low-growing shrubs within the microplots. These forb-like woody plants, such as bunchberry and twinflower (*Linnaea borealis),* vary in forage value for cattle or wildlife. Also, some of the measured forage productivity values for all layers may be lower than actual values since there was evidence of recent livestock grazing at some sites.

Table 2. Average forage productivity of vegetation community types in the Saddle Hills study area in 1996.

Saddle Hills Vegetation Community Type		Average Productivity (kg/ha)			
		Gram.[1]	Forb	Shrubs	TOTAL
1	Aspen/prickly rose - low-bush cranberry/bluejoint (n=25)*	94	381	270	746
2	Aspen/prickly rose- low-bush cranberry / wild sarsaparilla (n=20)	43	313	214	570
3	Aspen/prickly rose-snowberry/awnless brome-bluejoint (n=2)	646	685	126	1457
4	Aspen/Canada buffaloberry/bunchberry (n=16)	74	255	252	582
5	Aspen-balsam poplar/green alder/bluejoint (n=16)	70	271	374	714
6	Aspen-balsam poplar/red-osier dogwood-prickly rose (n=12)	103	360	323	786
7	White spruce/bunchberry/feathermoss (n=4)	<1	108	75	183
8	Lodgepole pine-white spruce/common Labrador tea / feathermoss (n=1)	19	49	22	90
9	Lodgepole pine/green alder/bunchberry (n=1)	16	368	97	481
10	Black spruce-tamarack/common Labrador tea / Sphagnum moss (n=1)	331	146	287	764
11	Bluejoint -beaked sedge / buck-bean (n=1)	2099	34	0	2134
13	Upland shrubland (n=1)	152	580	359	1092

* n - number of sites sampled ; Miscellaneous wetland communities (Type 12) were not sampled;
[1] Gram. - graminoids

4.4 Significant Features

Significant features of the Saddle Hills study area are summarized below. Significant sites or areas deserving special mention are identified on Map 2, with a detailed discussion of each presented below and in Section 5.0.

4.4.1 Significant Geological/Landform Features

The most significant geological feature of the study area is the steep escarpment that forms the northern extremity of the Saddle Hills (Map 2). This escarpment is formed by the bedrock dipping slightly towards the south and represents the only significant elevation change found in the region. It also provides habitat for a wintering elk (*Cervus canadensis*) population (Alberta Fish and Wildlife Division 1985a, D. Hervieux, personal communication).

The Bad Heart River valley is also a significant landform feature. This valley provides habitat for numerous wildlife species including mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), elk (*Cervus canadensis*), and black bear (*Ursus americanus*). Its south-facing valley walls support a variety of grassland and shrubland communities.

4.4.2 Significant Hydrological Features

The most prominent hydrological feature of the Saddle Hills study area is the Bad Heart River and its tributaries. This river supports the only substantial fish population in the area (Alberta Fish and Wildlife Division 1985b, TERA Environmental Consultants 1993). Other important hydrological features include Kleskun Creek and tributaries, Braeburn Creek and other tributaries of the Saddle (Burnt) River, and Mulligan Creek, Grande Prairie Creek and numerous unnamed creeks of the Bear River drainage.

Hilltop Lake is also a significant hydrologic feature found within the study area (Map 2). It represents the largest lake and the only one utilized by waterfowl to any extent. It also provides a key recreational resource for the surrounding human population.

4.4.3 Significant Historic and Archaeological Features

At least one historic site and eight prehistoric sites are known to exist within the study area (Alberta Forestry, Lands and Wildlife 1987). The extreme sensitivity of these sites prevent them from being included in the Significant Features map with this report. Although no major surveys have been conducted in this area, there is a high likelihood that additional sites exist. Because of this, Alberta Forestry, Lands and Wildlife (1987) has rated the archaeological resource sensitivity of this area as high.

The archaeological sites in the area represent the remains of numerous prehistoric hunting and gathering cultures that have frequented the area for the past 12 000 years or more. Most of the recorded archaeological sites have been related to the exploitation of the wildlife resources. These sites include small hunting and fishing camps and tool remains.

Site specific archaeological investigations are currently conducted in conjunction with the referral process for petroleum development applications.

4.4.4 Significant Palaeontological Features

Although no palaeontological sites are recorded within the study area, there is a high probability of their presence. The area adjacent to the Bad Heart River and the tributaries of the Saddle (Burnt) River are specifically rated as high (Tyrell Museum of Palaeontology 1984).

4.4.5 Significant Flora

No rare plant species were recorded in the Saddle Hills study area during the biophysical inventory fieldwork in 1995. This does not mean that rare plant species do not occur within the study area. Successful identification of rare plant populations is best accomplished through intensive survey methods designed to achieve this purpose. The biophysical survey methodology employed during 1995 field work, the timing of the survey (late August) in relation to plant species' phenology and the relatively low sampling intensity reduced the chances of locating rare plant populations. Another factor influencing the detection of rare plants is that species may be evident in one year but not in another due to drought or other climatic factors.

A number of rare plant species predicted to occur within the Saddle Hills study area were identified as part of a study by TERA Environmental Consultants Ltd. (1993), for the nearby CONWEST Exploration Company Ltd. Sexsmith Gas Plant. A list of rare flora found near or within the Saddle Hills study area is given in Appendix 7.

4.4.6 Significant Fauna

Table 3 presents a list of Saddle Hills fauna considered to be at risk in Canada or within the province. One mammal species, the wolverine (*Gulo gulo*), has been designated by the Committee on the Status of Endangered Wildlife in Canada as nationally 'vulnerable', because of characteristics that make it particularly sensitive to human activities or natural events (COSEWIC 1998). On a provincial scale, blue-listed species include three mammal and one bird species; four mammal and eight bird species are yellow A- or B-listed (Alberta Environ. Prot. 1996) (refer to Section 3.0 for ranking definitions and criteria).

Human impacts leading to habitat loss, over-exploitation, and non-native species introduction do not affect all species equally. At greatest risk are species with small populations, species with fluctuating population levels, and species with slow rates of population growth. Thus, certain wildlife species in the Saddle Hills present more of a conservation concern than others. Table 4 lists groups of organisms that are particularly susceptible to disturbance and extinction (Terborgh 1974, Pimm *et al.* 1988, Reid and Miller 1989, Orians and Kunin 1990).

Some Saddle Hills wildlife, not designated as rare, are here included in the category of significant fauna based on a combination of the criteria listed in Table 4. The viability of these species is considered representative of ecosystem integrity, and their conservation necessary to preserve biological diversity. The following species or species assemblages, though not at risk, are considered significant within the Saddle Hills study area: elk (*Cervus canadensis*), moose (*Alces alces*), certain furbearers, raptors, woodpeckers and many songbirds.

Table 3. Rare fauna of the Saddle Hills region, Alberta.

SPECIES		Provincial / National Conservation Status[1]
northern long-eared bat	*Myotis septentrionalis*	Blue-listed in Alberta
northern flying squirrel	*Glaucomys sabrinus*	Yellow B-listed in Alberta
grizzly bear[2]	*Ursus arctos*	Blue-listed in Alberta
fisher	*Martes pennanti*	Yellow B-listed in Alberta
long-tailed weasel	*Mustela frenata*	Yellow A-listed in Alberta
wolverine	*Gulo gulo*	Designated by COSEWIC as vulnerable in Canada Blue-listed in Alberta
Canada lynx	*Lynx canadensis*	Yellow B-listed in Alberta
horned grebe	*Podiceps auritus*	Yellow A-listed in Alberta
trumpeter swan	*Cygnus buccinator*	Blue-listed in Alberta
bald eagle	*Haliaeetus leucocephalus*	Yellow B-listed in Alberta
northern harrier	*Circus cyaneus*	Yellow A-listed in Alberta
sharp-tailed grouse	*Tympanuchus phasianellus*	Yellow A-listed in Alberta
great gray owl	*Strix nebulosa*	Yellow B-listed in Alberta
pileated woodpecker	*Dryocopus pileatus*	Yellow B-listed in Alberta
western tanager	*Piranga ludovicianus*	Yellow B-listed in Alberta
clay-coloured sparrow	*Spizella pallida*	Yellow A-listed in Alberta

[1] Refer to Section 3.0 above for ranking definitions and criteria
[2] presence in Saddle Hills considered extralimital

Table 4. Organisms Susceptible To Local Extinction Processes.

GROUP OF ORGANISM	DESCRIPTION
Species at higher trophic levels	Species high in the food chain tend to be large, rare animals with slow rates of population growth.
Local endemics	Species with restricted ranges are often threatened by habitat loss, as exemplified by the high rate of island species extinction.
Species with chronically small populations	This category overlaps the first. Since many species at higher trophic levels have sparsely distributed populations, habitat restriction or fragmentation may reduce their populations to extremely low levels. However, the population sizes of species at lower trophic levels may also be low in a given habitat or region.
Largest members of a guild	Physically large species have high metabolic demands, require large habitats, and tend to occur in low densities. Thus, the largest species within a guild tend to be at higher risk than smaller species.
Species with poor dispersal and colonization ability	As with local endemics, species with narrow habitat requirements and species which cannot disperse easily to new habitats are at risk even if their population is widespread.
Species with colonial nesting habits	Colonial nesting species are particularly susceptible to over-exploitation or potential loss of breeding habitat.
Migratory or nomadic species	Migratory species are dependant upon suitable habitat in both their summer and winter ranges and along their migratory routes. Nomadic, or far-ranging species, require large tracts of wilderness areas and the potential for adverse effects of habitat changes on these populations is high.
Species dependent on unreliable resources	These species' populations fluctuate greatly and they face increased threats when their population is low.

4.4.6.1 Significant Mammal Species

Based on geographic distributions identified by Smith (1993), the Saddle Hills study area is anticipated to provide habitat for almost 50 mammal species, many of which are large game species of extreme economical, ecological, and aesthetic value (Appendix 8). Seven mammal species of concern are predicted to occur in the study area (Table 3).

A broad range of furbearing animals inhabit the Saddle Hills. Of the 18 species of furbearers in the Saddle Hills, four species, the fisher, wolverine, long-tailed weasel and Canada lynx, are recognized as species of concern within the province (Table 3; Alberta Environ. Prot. 1996). Trapping harvests of fisher have continued to decline since 1985 (Alberta Environ. Prot. 1996). This species prefers climax coniferous forests, especially in the vicinity of watercourses (Banfield 1974). According to Alberta Environ. Prot. (1996), the current wolverine population size in Alberta is estimated at less than 1000 individuals. Habitat

loss is cited as the likely cause of declines of wolverines, long-tailed weasels and Canada lynx (Alberta Environ. Prot. 1996).

The river otter is a species which reaches the southern limits of its range near the Saddle Hills. Previously designated as "blue-listed", the species has been de-listed (Alberta Environ. Prot. 1996). However, the species is considered significant, due to an inherently scarce population. Also, river otters' requirements for clean, unpolluted, non-impacted habitats and their intolerance of human disturbances further complicates their active conservation in Alberta, particularly in severely impacted areas such as the Saddle Hills.

4.4.6.2 Significant Avifauna

Nine bird species of the Saddle Hills are recognized as species of concern (Table 3). This includes two species dependent on wetlands, three birds of prey, and several species of forested habitats.

The potential presence of trumpeter swans (*Cygnus buccinator*) in the study area warrants considerable attention. The exact status of trumpeter swan habitat use in the Saddle Hills is not known, but potential nesting habitat exists in the study area. Trumpeter swans usually prefer shallow, isolated productive lakes or wetlands characterized by emergent vegetation (Semenchuk 1992) often with beaver activity. Alternatively, Saddle Hills may support dispersing breeding or non-breeding individuals from adjacent wetlands. An individual trumpeter swan was recorded on an unnamed wetland in the study area during field work in the summer of 1995. It is unlikely that this observation represents a breeding pair, however.

Among resident birds of prey of the Saddle Hills area, the bald eagle (*Haliaeetus leucocephalus*) and great gray owl are the most significant species. The bald eagle represents a unique management challenge to resource planners and land users. It formerly nested throughout Alberta but breeding is now restricted largely to northern portions of the province (Semenchuk 1992). While the exact status of bald eagles in Alberta is not known, the species has been yellow B-listed in Alberta (Alberta Environ. Prot. 1996). Raptors such as bald eagle are exceptionally susceptible to disturbance during nesting, and their nest sites should be protected wherever possible.

The great gray owl is a naturally scarce species distributed widely across appropriate forested habitats in

Alberta. Great gray owls are designated as Yellow B-listed in Alberta (Alberta Environ. Prot. 1996). They nest in forested habitats and exhibit a preference for mature and older forest stands (Bull and Henjum 1990, Duncan 1992, Habeck 1994).

Of the six species of woodpeckers anticipated to nest in the Saddle Hills area (Appendix 8), one species, the pileated woodpecker (*Dryocopus pileatus)*, has been designated at risk (Table 3). Pileated woodpeckers, as well as other species of woodpeckers, are ecologically important components of the Saddle Hills boreal forest habitats, as they are primary excavators of one or more nest or roost cavities per year. Management for protection of the pileated woodpecker and its nesting sites would concomitantly benefit many other wildlife species. Nesting cavities are often abandoned by woodpeckers after the young fledge, allowing numerous other cavity-dependent wildlife species to inhabit old and unused woodpecker cavities. Secondary cavity-nesters in the Saddle Hills area that are unable to excavate their own cavities include swallows, bluebirds, kestrels, flycatchers, and a few ducks and owls. Northern flying squirrel, a yellow B-listed mammal (Alberta Environ. Prot. 1996) and pine marten also utilize woodpecker cavities extensively. Quinlan *et al.* (1990) identified approximately 40 vertebrate species that are associated with the habitat typically used by three-toed and hairy woodpeckers.

Upland nesting waterfowl species such as bufflehead (*Bucephala albeola*) and common goldeneye (*B. clangula*) species prefer to nest in tree cavities excavated by flickers (*Colaptes* spp.), within 200 m of a wetland (Gauthier and Smith 1987). Maintenance of a mosaic of wetlands and mixedwood forests in close association are required for such species.

Aspen mixedwood forests support one of the most diverse communities of breeding songbirds in North America (Robbins *et al.* 1989), and this forest type is widespread throughout the Saddle Hills. There is much physiographic variation within the Saddle Hills study area, provided by the interspersion of grassland, aspen groves, mixedwood forests, and coniferous stands. Complexity, both of the forest strata and of the forest mosaic, is the key to diversity of avian community structure in aspen mixedwood forests.

4.4.6.3 Significant Fauna by Community Type

Since vegetation cover type is actually an expression of a variety of biophysical conditions such as soil, aspect and relief, it generally offers a valid prediction of habitat suitability for many wildlife species. As an aid in understanding potential wildlife use, Table 5 interprets vegetation community types as "habitat types" for selected significant fauna in the Saddle Hills.

Table 5. Significant Fauna by Community Type.

Community Type	Wildlife Species				
	moose	elk	black bear	pileated woodpecker	great gray owl
Aspen/prickly rose-low-bush cranberry/bluejoint	●●●			●●●	
Aspen/prickly rose-low-bush cranberry/wild sarsaparilla	●●			●	
Aspen/prickly rose-snowberry/awnless brome-bluejoint	●●●	●●	●●●		
Aspen/Canada buffaloberry/bunchberry	●	●	●●●	●	
Aspen-balsam poplar/green alder/bluejoint	●●		●	●●	
Aspen-balsam poplar/red-osier dogwood-prickly rose	●●●				
White spruce/bunchberry/feathermoss	●	●	●	●	●●●
Lodgepole pine-white spruce/common Labrador tea/feathermoss	●	●	●		
Lodgepole pine/green alder/bunchberry	●●		●		
Black spruce-tamarack/common Labrador tea/sphagnum moss	●●●				●●
Bluejoint-beaked sedge/ buck-bean		●●			●●
Miscellaneous wetland communities	●●●	●●			●
Upland shrubland		●	●●		

● - some use; ●● - moderate use; ●●● - extensive use

4.4.7 Significant Sites/Areas

Wetlands are dispersed throughout the study area, occurring particularly in association with the drainage of the Bad Heart River. A high diversity of wildlife species can be found in these complexes. The significance of suitable wetlands may be high due to disproportionate levels of use in relation to their occurrence.

The Bad Heart River and its tributaries, the numerous wetland complexes associated with the Bad Heart River drainage, and the Bear River tributaries are considered environmentally significant areas because of their potential to provide winter habitat for moose (CLI 1973, Alberta Fish and Wildlife Division 1985a). These areas, along with the northern escarpment of the Saddle Hills themselves and the Saddle (Burnt) River valley immediately north of the study area, also provide much of the wintering habitat for the regional elk population.

Significant elk habitats in the Saddle Hills are areas that provide critical resources, such as food, winter thermal cover or summer calving habitat. In winter, elk in Alberta utilize saskatoon and aspen (Morgantini 1979), willow (*Salix* spp.), rose (*Rosa* sp.), red-osier dogwood, bog birch, and low-bush cranberry (Stelfox 1980). However, snow depth and condition affect elk access to food sources (Morgantini and Hudson 1983). Elk therefore select sites protected by topography or vegetation from strong winds, snow crusting and snow drifting in winter and early spring. Within the Saddle Hills, such sites are often found in large, linear riparian areas such as the Bad Heart River valley and its adjacent uplands. Mineral licks have also been identified by Alberta Fish and Wildlife Services as significant sources of nutrients for all ungulates in the area (Alberta Fish and Wildlife Division 1985a).

Riparian areas such as Grande Prairie Creek and Kleskun Creek valleys, and tributaries to the Bear River in the southern portion of the study area, also perform critical linking functions for deer travelling between agricultural and forested lands.

The development of a network of roads and trails which has accompanied most types of human activity in the Saddle Hills impacts ungulate populations in a number of ways, including providing hunter access to previously inaccessible populations. While land reclamation can improve productivity of elk by providing quality forage (Fargey and Hawley 1989), it has also been suggested that the negative impacts of increased

access significantly reduce net habitat utilization (Smith 1985, Christensen *et al.* 1993, Unsworth *et al.* 1993).

The following is a summary of some of the significant sites identified in the Saddle Hills study area. Each significant area is outlined on Map 2, and represented by a map code number (Site No.). Key features of each site are listed below, and in Section 5.0.

Regionally Significant Sites

Site/Area Name	Key Features
Bad Heart River (Site No. 1)	- important elk production and winter range - acts as an corridor for many wildlife species - key fisheries habitat - important habitat for many plant and wildlife species - significant hydrologic and landform feature
North Escarpment (Site No. 3)	- regionally significant geologic feature - most significant elevation change in the region - important elk winter range

Locally Significant Sites

Site/Area Name	Key Features
Saddle (Burnt) River Tributaries (Site No. 5)	- key ungulate habitat - acts as an corridor for many wildlife species - key fisheries habitat - important habitat for many plant and wildlife species - significant hydrologic and landform feature
Bear River Tributaries (Site No. 4)	- key ungulate habitat - acts as an corridor for many wildlife species - key fisheries habitat - important habitat for many plant and wildlife species - significant hydrologic and landform feature
Kleskun Creek Tributaries (Site No. 2)	- key ungulate habitat - acts as an corridor for many wildlife species - key fisheries habitat - important habitat for many plant and wildlife species - significant hydrologic and landform feature
Hilltop Lake (Site No. 6)	- locally significant hydrologic feature - key recreational resource

4.5 Sensitive Features

Environmental sensitivity ratings are often used as an evaluation of the performance of a site in response to various land uses or disturbance types (Bentz and Saxena 1993, O'Leary *et al.* 1993). Disturbances occurring on lands with a low sensitivity rating can easily be remedied by standard operating procedures. Conversely, other lands may be more sensitive to disturbance because they possess at least one of the following characteristics (Bentz and Saxena 1993):

- a very high susceptibility to erosion;
- severe limitations to revegetation; or
- distinctive, rare or unusual landforms, wildlife populations or plant communities that are regionally, provincially, nationally or internationally important.

The identification of sensitive features encompasses the overlaying of three mapping themes, specifically, vegetation community types, significant features and slope class. This method is consistent with that developed for previous sensitive areas studies (Bradshaw *et al.* 1994, 1995; Bruhjell *et al.* 1996). The resulting polygons are then evaluated and classified according to the following classes:

High: The disturbance can be expected to result in a complete loss of the significant natural feature or require major mitigation and very restrictive operating conditions to maintain the vital ecological functions of the feature or the site. Site reclamation would be expected to be very difficult, and the potential for the site to be successfully reclaimed would be anticipated to be low.

Moderate: The disturbance will result in considerable loss or modification of the significant natural feature. Significant mitigation and restrictive operating conditions are likely required to maintain the vital ecological functions of the feature.

Low: The disturbance will result in minor loss or modification to the significant natural feature. Some mitigation and normal operating restrictions may be required to maintain the long term viability and vitality of the feature.

Insignificant: The disturbance will have no measurable impact on the significant ecological feature.

The Saddle Hills study area as a whole is considered to be of low to moderate sensitivity due to subtle slopes and the lack of distinctive, rare or unusual landforms. However, some areas within the study area can be considered more fragile than others. This difference is presented in Map 3 as a rating of the sensitivity of

sites to physical disturbance, defined here as the degree of anticipated negative effects, usually as caused by water erosion, if the ground cover is disturbed (such as by petroleum exploration activities).

Highly sensitive areas within the study area include the northern escarpment, Hilltop Lake and other larger bodies of water and adjacent shorelines, and the valleys of Bad Heart River, tributaries of Kleskun Creek, Saddle (Burnt) River and Bear River (Map 3). Most of the water bodies within the study area are classified as highly sensitive. These sites support significant fauna species. The sites are susceptible to water erosion due to steep slopes and fine textures.

Disturbance to either the water course itself or adjacent land units increases the sediment loading of these water bodies which in turn affects both aquatic flora and fauna. Also, disturbances adjacent to water bodies also lower their value as wildlife corridors.

Moderately sensitive sites occur throughout the area and were generally delineated by slope and soil texture (Map 3). Major portions of the study area consist of gently undulating, fine textured morainal materials, and are classified as being of low sensitivity.

4.6 Disturbance Features

Disturbance features encompass those sites or areas where the impact of man's activities are readily observed from aerial photography and the ground. Preliminary disturbance features mapping was accomplished through the interpretation of 1:30 000 (1989) black and white aerial photographs, 1:20 000 (1995) orthophoto mosaics and 1:50 000 (1992) Provincial Resource Base Maps. Disturbance features included, but were not limited to:

- Access Development: - including improved roads, unimproved roads and trails
- Agricultural: - including annual croplands, improved pastures, cattle watering holes (dugouts), farm residences and fencelines
- Industrial: - including active and reclaimed wellsites, pipelines, right-of-ways, major transmission lines and industrial facility sites

The impact of human activity on the Saddle Hills is readily observed from both the ground and from aerial

photographs. For the most part, agricultural disturbances are confined to the boundaries of the study area, while linear and industrial disturbances in the form of trails, cutlines, pipelines, gravel and paved roads are spread evenly throughout the study area. These disturbance features are depicted in Map 4. Surface disturbance and subsequent weed invasion is associated with all of the disturbance types listed above.

5.0 CHECKLISTS OF SIGNIFICANT FEATURES

The following are checklists and further descriptions of mappable significant features identified in the Saddle Hills study area. Locations of these sites are presented in Map 2. As well, an overall sensitivity rating is given for each site or feature.

The significant features checklists are grouped by level of significance, from regional to local significance.

Site Name: **Bad Heart River**

Site Location: dissecting the study area

Description:

The site includes the valley slopes associated with the Bad Heart River and its tributaries, and associated floodplains.

Significance: **Regional**

- significant hydrologic and landform feature
- important elk (*Cervus canadensis*) production and winter range
- acts as an corridor for many wildlife species
- key fisheries habitat
- economically important fish species include Arctic grayling (*Thymallus arcticus*), lake white fish (*Coregonus clupeaformis*), northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*) and burbot (*Lota lota*)
- south facing slopes provide habitat for regionally significant grassland and shrubland communities that include species such as northern wheat grass (*Agropyron dasystachyum*), slender wheat grass (*Agropyron trachycaulum*), western wheat grass (*Agropyron smithii*), bastard toadflax (*Comandra umbellata*) and harebell (*Campanula rotundifolia*)

Sensitivity: **High**

Comments:

- agricultural encroachment on riparian vegetation

References:

- 1995 field investigations
- D. Hervieux, pers. comm
- D.A. Westworth & Associates Ltd. (1992)
- Key Wildlife Area Maps (1985)
- Fisheries Resources Map (1985)
- Van Waas (1972)

Site Name: **Northern Escarpment**

Site Location: dissecting the northern portion of the study area

Description:

The unit consists of a north facing slope formed by the southern incline of the local bedrock. It occurs in the northern section of the study area and marks the northern extremity of the Saddle Hills.

Significance: **Regional**

- regionally significant geologic feature
- most severe elevation change in the region
- important elk (*Cervus canadensis*) winter range

Sensitivity: **High**

Reference:

- 1995 field investigations
- D. Hervieux, pers. comm.
- Van Waas (1972)

Site Name: **Saddle (Burnt) River Tributaries**

Site Location: northern portion of the study area

Description:

The site includes tributaries of the Saddle (Burnt) River including Braeburn Creek.

Significance: **Local**

- key ungulate habitat
- acts as an corridor for many wildlife species
- key fisheries habitat
- important habitat for many plant and wildlife species
- significant hydrologic feature

Sensitivity: **High**

Comments:

- agricultural encroachment on riparian vegetation

References:

- 1995 field investigations
- Wildlife Key Area Maps (1985)
- Van Waas (1972)

Site Name: **Bear River Tributaries**

Site Location: southwest portion of the study area

Description:

The site includes tributaries of the Bear River including Grande Prairie and Mulligan Creeks.

Significance: **Local**

- key ungulate habitat
- acts as an corridor for many wildlife species
- key fisheries habitat
- important habitat for many plant and wildlife species
- significant hydrologic feature

Sensitivity: **High**

Comments:

- agricultural encroachment on riparian vegetation

References:

- 1995 field investigations
- Wildlife Key Area Maps (1985)
- Van Waas (1972)

Site Name: **Kleskun Creek Tributaries**

Site Location: southeast portion of the study area

Description:

The site includes tributaries of Kleskun Creek.

Significance: **Local**

- key ungulate habitat
- acts as an corridor for many wildlife species
- key fisheries habitat
- important habitat for many plant and wildlife species
- significant hydrologic feature

Sensitivity: **High**

Comments:

- agricultural encroachment on riparian vegetation

References:

- 1995 field investigations
- Wildlife Key Area Maps (1985)
- Van Waas (1972)

Site Name: **Hilltop Lake**

Site Location: located in parts of NE 20 & SE 29 - Twp.75 - Rge.7 - W6M

Description:

The site is a locally significant hydrologic feature and includes an on-site campground and day use area.

Significance: **Local**

- key recreational resource
- the site represents the only significant lake community found within the Saddle Hills study area
- the only waterfowl habitat that is used to any extent in the study area

Sensitivity: **High**

References:

- 1995 field investigations
- Van Waas (1972)

6.0 DATA GAPS

The identification of significant features, particularly of rare flora and fauna, relied heavily on review of existing information as field time allocated for the project was insufficient to conduct the intensive surveys required to identify populations in the field. Extrapolation was often required of data from studies in areas adjacent to the Saddle Hills study area. This study will therefore be best used as an initial source to "flag" potential areas of concern related to any proposed resource development activity. Detailed field study will be required to confirm site-specific occurrences of significant flora and fauna within the study area.

7.0 LITERATURE CITED

Achuff, P.L. 1994. Natural regions, subregions and natural history themes of Alberta, a classification for Protected Areas management. Prep. for Parks Services, Alberta Environ. Prot. 72 pp.

Alberta Environmental Protection. 1993. Alberta plants and fungi - master species list and species group checklists. Pub. No.: Ref. 75.

Alberta Environmental Protection. 1994. Ecological land survey site description manual. Canadian Forest Service and Alberta Land and Forest Services. Edmonton, AB. 165 pp.

Alberta Environmental Protection. 1996. The status of Alberta wildlife. Wildlife Manage. Div., Natural Resources Serv., Alberta Environ. Prot. Publ. No. I/620. Edmonton. 44 pp.

Alberta Fish and Wildlife Division. 1985a. Wildlife Key Area Maps (1:250,000 scale) - 83M. Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division. Edmonton, AB.

Alberta Fish and Wildlife Division. 1985b. Fisheries Resource Maps (1:250,000 scale) - 83M. Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division. Edmonton, AB.

Alberta Fish and Wildlife Division. 1996. Unpublished trapper harvest data for mapsheet 83M. Alberta Environmental Protection, Fish and Wildlife Division. Edmonton, AB.

Alberta Forestry, Lands and Wildlife. 1987. Archaeological resource sensitivity zones. Resource Evaluation and Planning Division. Edmonton, AB. map.

Argus, G.W. and K.M. Pryer. 1990. Rare vascular plants in Canada: our natural heritage. Canadian Museum of Nature, Ottawa. 191 pp. + maps.

Banfield, A.W.F. 1974. The mammals of Canada. Univ. of Toronto Press, Toronto. 438 pp.

Bentz, J.A and A. Saxena. 1993. Significant ecological features inventory of the Lesser Slave Lake Integrated Resource Planning Area. Prepared for Resource Information Division, Alberta Environmental Protection, Edmonton, Alberta by Geowest Environmental Consultants Ltd., Edmonton, Alberta. 128 pp.

Bradshaw, D.A., A. Saxena and T. Normand. 1995. Biophysical overview, significant, sensitive and disturbance features of the Purple Springs Sensitive Area. Prepared by Geowest Environmental Consultants Ltd. for Alberta Environmental Protection. Edmonton, AB.

Bradshaw, D.A., A. Saxena, D.J. O'Leary, and J.A. Bentz. 1994. Biophysical overview, significant, sensitive, and disturbance features of the Lost River Sensitive Area. Prepared by Geowest Environmental Consultants Ltd. for Alberta Environmental Protection. Edmonton, AB.

Bruhjell, D.R., J.A. Bentz, R. Shultz and A. Saxena. 1996. Biophysical and significant ecological features of the Kootenay Plains Ecological Reserve. Prepared by Geowest Environmental Consultants Ltd. for Alberta Environmental Protection. Edmonton, AB.

Bull, E.L. and M.G. Henjum. 1990. Ecology of the great gray owl. United States Department of Agriculture, Forest Service. Gen. Tech. Rep. PNW-265. Pacific Northwest Forest Experiment Station. Portland, OR.

Canada Soil Survey Committee, Subcommittee on Soil Classification. 1987. The Canadian system of soil classification. Can. Dep. Agric. Publ. 1646. Supply and Services Canada,Ottawa. 164 pp.

CLI (Canada Land Inventory). 1971. Land capability for wildlife - waterfowl. 1:250,000 scale map for 83M. Canada Land Inventory. Ottawa, ON.

CLI (Canada Land Inventory). 1973. Land capability for wildlife - ungulates. 1:250,000 scale map for 83M. Canada Land Inventory. Ottawa, ON.

Christensen, A.G., L.J. Lyon, and J.W. Unsworth. 1993. Elk management in the Northern Region: Considerations in forest plan updates or revisions. United States Department of Agriculture, Forest Service. Gen. Tech. Rep. INT-303. Intermountain Research Station. Ogden, UT. 10 pp.

COSEWIC. 1998. Canadian species at risk, April 1998. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario. 21 pp.

D.A. Westworth & Associates Ltd. 1992. An overview of potential forest harvesting impacts on fish and fish habitat in the northern boreal forests of Canada's Prairie Provinces. Prepared for Alberta Forestry, Lands and Wildlife. Edmonton, AB.

Duncan, J.R. 1992. Influence of prey abundance and snow cover on great gray owl breeding dispersal. Ph.D. Thesis. University of Manitoba. Winnipeg, MB.

Eagles, P. 1984. The Planning and Management of Environmentally Sensitive Areas. Longman: London and New York.

Environment Canada. 1993. Canadian climate normals, 1961- 1990. Atmospheric Environ. Service, Ottawa.

Fargey, P.J. and A.W.L. Hawley. 1989. Seasonal patterns of forage selection by wapiti (*Cervus elaphus*) in relation to land reclamation. AECV89-R3. Alberta Environmental Centre. Vegreville, AB. 112 pp.

Gauthier, G. and J.N.M. Smith. 1987. Territorial behavior, nest site availability, and breeding density in bufflehead. J. Anim. Ecol. 56: 171-184.

Habeck, J.R. 1994. Dynamics of forest communities used by great gray owls. Pages 176-201 in: Hayward, G.D. and J. Verner (eds). Flammulated, Boreal, and Great Gray Owls in the United States: A Technical Conservation Assessment. United States Department of Agriculture, Forest Service. Gen. Tech. Rep. RM-253. Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Morgantini, L.E. 1979. Habitat selection and resource division among bighorn sheep, elk, and mule deer in western Alberta. M.Sc. Thesis. University of Alberta. Edmonton, AB.

Morgantini, L.E. and R.J. Hudson. 1983. Nutritional significance of altitudinal migrations for wapiti. Agric. For. Bull. 62: 109-112.

Moss, E.H. 1983. Flora of Alberta. Second edition. Revised by J.G. Packer. University of Toronto Press: Toronto. 687 pp.

Nelson, J.S. and M.J. Paetz. 1992. The Fishes of Alberta. 2nd Edition. University of Alberta Press. Edmonton, AB.

Odynsky, W.M., J.D. Lindsay, S.W. Reeder and A. Wynnyk. 1961. Reconnaissance soil survey of the Beaverlodge and Blueberry Mountain sheets. Research Council of Alberta, Rep. No. 20. 123 pp. + maps.

Odynsky, W.M. and J.D. Newton. 1959. Soil survey of the Rycroft and Watino sheets. Research Council of Alberta. Report No. 56. 84 pp. + maps..

O'Leary, D., J. Bentz, D. Ealey and A. Schwabenbauer. 1993. Inventory of environmentally sensitive and significant natural areas, City of Edmonton. Prepared for Planning and Development, City of Edmonton by Geowest Environmental Consultants Ltd., Edmonton, Alberta. 299 pp.

O'Leary, D. and D. Downing. 1986. Integrated Resource Inventory of the Grande Prairie County West study area. Alberta Forestry, Lands and Wildlife; Resource Evaluation and Planning Branch. Edmonton, AB.

Orians, G.H. and W. Kunin. 1990. Ecological uniqueness and the loss of species. In: Proc. of the Lake Wilderness Conf. on the Cons. of Genetic Resources. University of Washington Press. Seattle, WA.

Packer, J.G. and C.E. Bradley. 1984. A checklist of the rare vascular plants in Alberta. Provincial Museum of Alberta Natural History Occasional Paper No. 5. Alberta Culture. 112 pp.

Pimm, S.L. H.L. Jones, and J. Diamond. 1988. On the risk of extinction. Amer. Naturalist 132: 757-785.

Quinlan, R.W., W.A. Hunt, K. Wilson, and J. Kerr. 1990. Habitat requirements of selected wildlife species in the Weldwood Forest Management Agreement Area. Alberta Forestry, Lands and Wildlife; Fish and Wildlife Division. Hinton, AB. 189 pp.

Reid, W.V. and K.R. Miller. 1989. Keeping Options Alive: The Scientific Basis for Conserving Biodiversity. World Resources Institute. Gland, Switzerland. 128 pp.

Robbins, C.S., D.K. Dawson, and B.A. Dowell. 1989. Habitat area requirements of breeding forest birds of the middle Atlantic States. Wildl. Monogr. 103: 1-34.

Russell, A. and A. Bauer. 1993. The Amphibians and Reptiles of Alberta. University of Calgary Press. Calgary, AB.

Semenchuk, G.P. 1992. The Atlas of Breeding Birds of Alberta. Federation of Alberta Naturalists. Edmonton, AB. 390 pp.

Smith, H.C. 1993. Alberta Mammals: An Atlas and Guide. Provincial Museum of Alberta. Edmonton, AB. 239 pp.

Smith, K. 1985. A preliminary elk (*Cervus elaphus*) management plan for the Edson Wildlife Management Area. Alberta Energy and Natural Resources, Fish and Wildlife Division. Edson, AB.

Stelfox, J.G. 1980. Nutritive value and preference ratings of common big game browse plants in Alberta. Unpubl. Rep. Canadian Wildlife Service. Edmonton, AB. 8 pp.

Strong, W.L. 1992. Ecoregions and ecodistricts of Alberta. Volume 1. Prepared by Ecological Land Surveys Ltd. for Alberta Forestry, Lands and Wildlife, Edmonton. Pub. No. T/244. 77 pp. + map.

Terborgh, J. 1974. Preservation of natural diversity: the problem of extinction-prone species. BioScience 24: 715-722.

TERA Environ. Consultants. 1993. Environmental impact assessment for the Conwest Exploration Company Limited Sexsmith Gas Plant. TERA Environmental Consultants Ltd.

Tyrell Museum of Palaeontology. 1984. Palaeontological resource sensitivity zones. Alberta Bureau of Surveying and Mapping. map.

United States Army Corps of Engineers. 1962. Pavement design for frost conditions. Engineering Manual 1110-1-306. United States Army Corps of Engineers. Washington, DC.

Unsworth, J.W., L. Kuck, M.D. Scott, and E.O. Garton. 1993. Elk mortality in the Clearwater drainage of northcentral Idaho. J. Wildl. Manage. 57(3): 495-502.

Van Waas, C. 1972. Saddle Hills land use plan. Alberta Department of Lands and Forests. Edmonton, AB. 66 pp. + maps.

Wallis, C., C. Bradley, M. Fairbarns and V. Loewen. 1987. The rare flora of Alberta. Volume 3: Species summary sheets. Alberta Forestry, Lands and Wildlife, Edmonton. Publ. No. T/155.

APPENDIX 1. Vegetation community type codes used in the polygon database.

CODE

1.	Aspen/prickly rose-low-bush cranberry/bluejoint
2.	Aspen/prickly rose-low-bush cranberry/wild sarsaparilla
3.	Aspen/prickly rose-snowberry/awnless brome-bluejoint
4.	Aspen/Canada buffaloberry/bunchberry
5.	Aspen-balsam poplar/green alder/bluejoint
6.	Aspen-balsam poplar/red-osier dogwood-prickly rose
7.	White spruce/bunchberry/feathermoss
8.	Lodgepole pine-white spruce/common Labrador Tea/feathermoss
9.	Lodgepole pine/green alder/bunchberry
10.	Black spruce-tamarack/common Labrador tea/Sphagnum moss
11.	Bluejoint - beaked sedge / buck-bean
12.	Miscellaneous Wetland Communities
13.	Upland Shrubland

APPENDIX 2. Latin names of plant species mentioned in this report.

COMMON NAME	LATIN NAME
Trees:	
Aspen	*Populus tremuloides*
Balsam fir	*Abies balsamea*
Balsam poplar	*Populus balsamifera*
Black spruce	*Picea mariana*
Lodgepole pine	*Pinus contorta*
Tamarack	*Larix laricina*
White spruce	*Picea glauca*
Shrubs:	
Basket willow	*Salix petiolaris*
Beaked willow	*Salix bebbiana*
Bog birch	*Betula glandulosa*
Bog cranberry	*Vaccinium vitus-idaea*
Bracted honeysuckle	*Lonicera involucrata*
Bristly black current	*Ribes lacustre*
Bunchberry	*Cornus canadensis*
Canada buffaloberry	*Shepherdia canadensis*
Common Labrador tea	*Ledum groenlandicum*
Dewberry	*Rubus pubescens*
Dwarf bilberry	*Vaccinium caespitosum*
Green alder	*Alnus crispa*
Low-bush cranberry	*Viburnum edule*
Prickly rose	*Rosa acicularis*
Pussy willow	*Salix discolor*
Red-osier dogwood	*Cornus stolonifera*
Saskatoon	*Amelanchier alnifolia*
Smooth willow	*Salix glauca*
Snowberry	*Symphoricarpos albus*
Twinflower	*Linnaea borealis*
White meadowsweet	*Spiraea betulifolia*
Wild red raspberry	*Rubus idaeus*
Willow	*Salix spp.*
Mosses and Lichens	
Brown moss	*Drepanocladus spp.*
Golden moss	*Tomenthypnum nitens*
Knight's plume moss	*Ptilium crista-castrensis*
Reindeer lichen	*Cladina mitis*
Schreber's moss	*Pleurozium schreberi*
Sphagnum moss	*Sphagnum spp.*
Stair-step moss	*Hylocomium spendens*
Studded leather lichen	*Peltigera aphthosa*
Tufted moss	*Aulacomnium palustre*

APPENDIX 2. (Cont'd)

Forbs and allies	
Bastard toadflax	*Comandra umbellata*
Bishop's-cap	*Mitella nuda*
Buck-bean	*Menyanthes trifoliata*
Common pink wintergreen	*Pyrola asarifolia*
Common cattail	*Typha latifolia*
Common yarrow	*Maiathemum canadense*
Common fireweed	*Epilobium angustifolium*
Harebell	*Campanula rotundifolia*
Large northern aster	*Aster modestus*
Marsh cinquefoil	*Potentilla palustris*
Northern bedstraw	*Galium boreale*
Palmate-leaved coltsfoot	*Petasites palmatus*
Showy aster	*Aster conspicuus*
Stiff club-moss	*Locopodium annotinum*
Tall lungwort	*Mertensia paniculata*
Water-hemlock	*Circuta maculata*
Water parsnip	*Sium suave*
Water arum	*Calla palustris*
Wild strawberry	*Fragaria virginiana*
Wild sarsaparilla	*Aralia nudicaulus*
Wild vetch	*Vicia americana*
Graminoids:	
Awned brome	*Bromus inermis*
Awned sedge	*Carex atherodes*
Beaked sedge	*Carex rostrata*
Bluegrass	*Poa sp.*
Bluejoint	*Calamagrostis canadensis*
Bulrush	*Scirpus spp.*
Hairy wild rye	*Elymus innovatus*
Melic grass	*Melica sp*
Northern wheat grass	*Agropyron dasystachyum*
Sedge	*Carex sp*
Slender wheat grass	*Agropyron trachycaulum*
Water sedge	*Carex aquatilis*
Western wheat grass	*Agropyron smithii*
Wheat grass	*Agropyron spp*

APPENDIX 3. Frost Design Classification.

Adapted from United States Army Corps of Engineers (1962)

Frost Group	Kind of Soil	% by weight, finer than 0.02 mm	Typical Soil Types (USCS)	Typical Soil Textures (CSSC)
F1	Gravelly soils	3-10	GW,GP,GW-GM,GP-GM	g
F2	Gravelly soils	10-20	GM,GW-GM,GP-GM	g,gL
	sands	3-15	SW,SP,SM,SW-SM,SP-SM	S,fS,cS
F3	Gravelly soils	over 20	GM,GC	gL,gC
	Sands except very fine silty sands	over 15	SM,SC	LS
	Clays, P.I. >12	-	CL,CH	C,SiC,L
F4	All silts	-	ML,MH	Si,SiL,SiC
	Very fine silty sands	over 15	SM	fSI,vfS
	Clays P.I.>12	-	CL,CL-ML	SC, SiCL
	Varved clays and otehr fine grained, banded sediments	-	CL & ML; CL,ML &SM; CL,CH &ML; CL,CH,ML & SM	L & CL;CL,L &SL;CL,C &L; CL,C,L & SL

APPENDIX 4. Rockiness Classes.

Rockiness is recorded as classes based on the percentage of surface occupied by exposed bedrock.

ROCKINESS	SURFACE OCCUPIED BY BEDROCK (%)
Non-rocky	<2
Slightly rocky	2-10
Moderately rocky	10-25
Very rocky	25-50
Exceedingly rocky	50-90

Definitions:

Rocky 0. Non-rocky land - bedrock exposure covers less than 2 percent of the surface and is more than 100 m apart. There is minor interference with tillage.

Rocky 1. Slightly rocky land - sufficient bedrock exposures to interfere with tillage but not to make intertilled crops impracticable. Depending on how the pattern affects tillage, rock exposures are roughly 35 - 100 m apart and cover 2 - 10 % of the surface, depending on the pattern.

Rocky 2. Moderately rocky land - sufficient bedrock exposures to make tillage of intertilled crops impractical, but soil can be worked for hay crops or improved pasture if other soil characteristics are favourable. Rock exposures are roughly 10 - 35 m apart and cover 10 - 25 % of the surface, depending on the pattern.

Rocky 3. Very rocky land - sufficient rock outcrop to make use of machinery impractical, except for light machinery where other soil characteristics are especially favourable for improved pasture. The land may have some use for wild pasture or forests, depending on other soil characteristics. Rock exposures or patches of soil covering too thinly over rock for use, are roughly 3.5-10 m apart and cover 25-50 % of the surface, depending on the patterns.

Rocky 4. Exceedingly rocky land - sufficient rock outcrops (or very thin soil over rock) to make all use of machinery impractical. The land may have some value for poor pasture or forests. Rock outcrops are 3.5 m or less apart and cover 50 - 90 % of the area.

APPENDIX 5. Surface Stoniness Classes. [1]

Adapted from Canada Soil Survey Committee (1987)

Stoniness Class	Description
Stony 0	non-stony phase - very few stones (<0.01 % of surface, stones >30 m apart)
Stony 1	slightly stony phase - some stones that hinder cultivation slightly or not at all (0.01 - 3 % of surface, stones 10 - 30 m apart)
Stony 2	moderately stony phase - enough stones to cause some interference with cultivation (0.1 - 3 % of surface, stones 2 - 10 m apart)
Stony 3	very stony phase - sufficient stones to handicap cultivation seriously; some clearing is required (3-15 % of surface, stones 1-2 m apart)
Stony 4	exceedingly stony phase - sufficient stones to prevent cultivation until considerable clearing is done (15-50 % of surface, stones 0.1 - 0.5 m apart)
Stony 5	excessively stony phase - too stony to permit cultivation; boulder or stone pavement (> 50 % of surface, stones <0.1 m apart)

[1] Phases of stoniness are defined on the basis of the percentage of the land surface occupied by fragments coarser than 15 cm in diameter.

APPENDIX 6. Weights of vegetation clipped from range quadrats at survey sites in the Saddle Hills, July 1996.

Site No.	Grass (gm)	Forbs (gm)	Shrubs (gm)		Site No.	Grass (gm)	Forbs (gm)	Shrubs (gm)
1	0.1	28	5.7		27	37.3	35.2	2.3
2	n/a	33.5	22		28	5.4	31	12.9
3	6.9	37.9	12.6		29	3.5	2.2	8.8
4	3.6	22.7	56.7		30	3.6	7.6	28.9
5	9.6	12.6	39.8		31	1.8	41.2	13.7
6	26.1	11.5	22.6		32	0	0	7.4
7	2.1	19.8	30		33	0.1	18.3	11
8	0	19.1	10.4		34	25	12	20.2
9	1.1	23.3	15		35	4.9	18.1	10.5
10	0	18	40.8		36	11.7	17	37.2
11	0.2	5.7	44.2		37	2.2	12	18
12	n/a	14.5	22.7		38	0.1	19.6	15.3
13	3.9	22.6	8.9		39	5.3	15.9	57.2
14	2.1	17.9	14.4		40	10.9	20.7	47.6
15	0.6	29.1	8.6		41	9.6	34.7	23.1
16	0.1	25.9	26.3		42	11	15.7	12.1
17	0.9	12.8	23		43	6.9	14.4	17.6
18	1.2	11.4	19.9		44	0.1	28.7	10.5
19	0	40.5	22.2		45	5.7	23.3	10.2
20	0.1	22.2	45.7		46	0.1	58.8	27.1
21	0.1	40.4	1.8		47	0.1	20.6	18
22	n/a	15.6	16.7		48	96.9	107.8	0.1
23	0	29.3	54.3		49	0.1	13.5	4.5
24	13	6.1	22.3		50	0.1	30.5	6.8
25	1.6	26.8	15.4		51	165.3	2.7	n/a
26	8.9	6.5	50.5		52	9	12.5	10.3
Plot No.	Grass (gm)	Forbs (gm)	Shrubs (gm)		Plot No.	Grass (gm)	Forbs (gm)	Shrubs (gm)

53	4.9	14	11.6		81	24.9	24.8	11.6
54	1.5	3.9	1.7		82	23.6	14	10.9
55	1.7	41.6	14.2		83	3	12.7	8.1
56	10.5	12.8	20.5		84	5	38.3	20.3
57	23.7	62.9	7.9		85	1.3	29	7.6
58	2.5	8.4	10		86	18.3	38.7	24.3
59	0.1	13.9	12		87	1.8	69.8	18.5
60	0	6.3	21.7		88	0.1	33.3	8.5
61	4.2	12.2	5.2		89	0.1	46.6	46.4
62	5.9	19.7	11.8		90	2.2	31.9	16.5
63	15.6	27	29.5		91	12.8	27.8	13.2
64	41.7	13.3	10.5		92	0.1	4	11.4
65	4.5	39	20.3		93	n/a	13.7	43.5
66	5.3	38.8	27		94	17.8	20.2	48.5
67	4.8	0.1	19.7		95	2.7	58.8	43.3
68	12	45.7	28.3		96	0.1	5.2	12.6
69	0.6	23.5	21		97	0.8	21.2	4.2
70	0	32	37.9		98	0.2	22.9	90.7
71	3.7	68	11.3		99	5.4	32.5	39.1
72	11.5	44.6	18.5		100	0	8.3	63.5
73	5.6	51.6	24.6					
74	11	24.6	1.9					
75	n/a	33.8	37.3					
76	10.4	31.9	0.1					
77	1.8	29.5	12.5					
78	7.6	26.2	11.2					
79	1	34.1	8.1					
80	0	1.5	1.3					

n/a - data not available

APPENDIX 7. Rare plant species which may occur in the Saddle Hills study area[1].

SPECIES	Common Name	Habitat	Alberta Status[2]
Aster umbellatus	Flat-topped White Aster	Moist woods, thickets & meadows	Rare
Cardamine pratensis	Meadow Bitter Cress	Bogs and swamps	Rare
Carex adusta	Browned Sedge	Dry acid soil; moist sandy ground under pine; stony ground	Unknown
Carex lacustris	Lake Sedge	Marshes & swampy woods	Unknown
Carex loliacea	Rye-grass Sedge	Marshes & sphagnum bogs	Rare
Carex trisperma	Three-seeded Sedge	Bogs & wet woods; muskeg	Rare
Carex vulpinoidea	Fox Sedge	Swampy ground	Abundance Unknown
Danthonia spicata	Poverty Oat Grass	Dry to moist open areas & open woodland	Abundance Unknown
Eleocharis compressa	Flattened Spike-rush	Sandy shores & marshy ground	Abundance Unknown
Eupatorium maculatum	Joe Pye-weed	Wet meadows & thickets	Locally Common
Geranium carolinanum	Carolina Wild Geranium	Dry rocky woods, disturbed sites	Rare
Juncus brevicaudatus	Short-tailed Rush	Shores & marshes; pioneer on wet ground	Locally Common
Luzula acuminata	Wood Rush	Moist woodland, clearings	Rare or Overlooked
Malaxis monophylla	White Adder's-mouth	Damp woods, banks & bogs	Rare
Monotropa hypopitys	Pine-sap	Moist woods; saprophytic in coniferous woods	Rare
Nymphara tetragona	Small White Water-lily	Ponds and quiet waters	Rare
Oryzopsis canadensis	Canadian Rice Grass	Open woods & hillsides	Locally Common
Oryzopis micrantha	Little-seed Rice Grass	Dry open areas & rocky slopes; sandy woodlands	Locally Common
Polygala paucifolia	Fringed Milkwort	Marshy coniferous woods	Rare

Potemogeton obtusifolius	Blunt-leaved Pondweed	Lakes & springs; cold springs, streams	Rare
Potamogeton robbinsii	Robbins Pondweed	Shallow water; shield Lakes	Rare or Overlooked
Rhynchospora capillacea	Slender Beak-rush	Calcareous bogs	Abundance Unknown
Sagittaria latifolia	Broad-leaved Arrowhead	Ponds & Lakes	Abundance Unknown
Scirpus clintonii	Clinton's Bulrush	Marshy ground & turfy shores	Local & Not Uncommon
Scirpus cyperinus	Wool-grass	Marshy ground	Abundance Unknown
Selaginella rupestris	Little Club-moss	Dry open areas; exposed sandy sites	Locally Common
Viola selkirkii	Great-spurred Violet	Moist woods	Very Local
Woodsia glabella	Smooth Woodsia	Moist calcareous rocks & shaded cliffs	Rare

1. Species List Source: TERA Environmental Consultants Ltd. 1993. Environmental impact assessment for the Conwest Exploration Company Limited Sexsmith Gas Plant. TERA Environmental Consultants Ltd.

2. Alberta Status, Source: Wallis, C., C. Bradley, M. Fairbarns and V. Loewen. 1987. The rare flora of Alberta: Volume 3, species summary sheets. Alberta Forestry, Lands and Wildlife.

APPENDIX 8. Wildlife species in the Saddle Hills region, Alberta.		
SPECIES		**Provincial / National Conservation Status***
HERPTILES		
tiger salamander	*Ambystoma tigrinum*	--
western toad	*Bufo boreas*	--
wood frog	*Rana sylvatica*	--
MAMMALS		
masked shrew	*Sorex cinereus*	--
dusky shrew	*Sorex monticolus*	--
water shrew	*Sorex palustris*	--
arctic shrew	*Sorex arcticus*	--
pygmy shrew	*Sorex hoyi*	--
little brown bat	*Myotis lucifugus*	--
northern long-eared bat	*Myotis septentrionalis*	*Blue-listed in Alberta*
long-legged bat	*Myotis volans*	--
silver-haired bat	*Lasionycteris noctivagans*	--
big brown bat	*Eptesicus fuscus*	--
hoary bat	*Lasiurus cinereus*	--
snowshoe hare	*Lepus americanus*	--
least chipmunk	*Tamias minimus*	--
woodchuck	*Marmota monax*	--
columbian ground squirrel	*Spermophillus columbianus*	--
red squirrel	*Tamiasciurus hudsonicus*	--
northern flying squirrel	*Glaucomys sabrinus*	*Yellow B-listed in Alberta*
beaver	*Castor candensis*	--
deer mouse	*Peromyscus maniculatus*	--
bushy-tailed woodrat	*Neotoma cinerea*	--
southern red-backed vole	*Clethrionomys gapperri*	--

heather vole	*Phenacomys intermedius*	--
meadow vole	*Microtus pennsylvanicus*	--
muskrat	*Ondatra zibethica*	--
northern bog lemming	*Synaptomys borealis*	--
meadow jumping mouse	*Zapus hudsonius*	--
western jumping mouse	*Zapus princeps*	--
porcupine	*Erethizon dorsatum*	--
coyote	*Canis latrans*	--
gray wolf	*Canis lupus*	--
red fox	*Vulpes vulpes*	--
black bear	*Ursus americanus*	--
grizzly bear	*Ursus arctos*	*Blue-listed in Alberta*
pine marten	*Martes americana*	--
fisher	*Martes pennanti*	*Yellow B-listed in Alberta*
ermine	*Mustela erminea*	--
least weasel	*Mustela nivalis*	--
long-tailed weasel	*Mustela frenata*	*Yellow A-listed in Alberta*
mink	*Mustela vison*	--
wolverine	*Gulo gulo*	*Designated by COSEWIC as vulnerable in Canada* *Blue-listed in Alberta*
striped skunk	*Mephitis mephitis*	--
river otter	*Lutra canadensis*	--
Canada lynx	*Lynx canadensis*	*Yellow B-listed in Alberta*
elk	*Cervus canadensis*	--
mule deer	*Odocoileus hemionus*	--
white-tailed deer	*Odocoileus virginianus*	--
moose	*Alces alces*	--

BIRDS		
common loon	*Gavia immer*	--
horned grebe	*Podiceps auritus*	*Yellow A-listed in Alberta*
eared grebe	*Podiceps nigricollis*	--
trumpeter swan	*Cygnus buccinator*	*Blue-listed in Alberta*
Canada goose	*Branta canadensis*	--
green-winged teal	*Anas crecca*	--
mallard	*Anas platyrhynchos*	--
northern pintail	*Anas acuta*	--
blue-winged teal	*Anas discors*	--
gadwall	*Anas strepera*	--
common goldeneye	*Bucephala clangula*	--
bald eagle	*Haliaeetus leucocephalus*	*Yellow B-listed in Alberta*
northern harrier	*Circus cyaneus*	*Yellow A-listed in Alberta*
red-tailed hawk	*Buteo jamaicensis*	--
American kestrel	*Falco sparverius*	--
merlin	*Falco columbarius*	--
ruffed grouse	*Bonasa umbellus*	--
sharp-tailed grouse	*Tympanuchus phasianellus*	*Yellow A-listed in Alberta*
American coot	*Fulica americana*	--
killdeer	*Charadrius vociferus*	--
spotted sandpiper	*Actitis macularia*	--
rock dove	*Columba livia*	--
great-horned owl	*Bubo virginianus*	--
great gray owl	*Strix nebulosa*	*Yellow B-listed in Alberta*
yellow-bellied sapsucker	*Sphyrapicus varius*	--
downy woodpecker	*Picoides pubescens*	--
hairy woodpecker	*Picoides villosus*	--
three-toed woodpecker	*Picoides tridactylus*	--

northern flicker	*Colaptes auratus*	--
pileated woodpecker	*Dryocopus pileatus*	*Yellow B-listed in Alberta*
western wood pewee	*Contopus sordidulus*	--
alder flycatcher	*Empidonax alnorum*	--
least flycatcher	*Empidonax minimus*	--
eastern kingbird	*Tyrannus tyrannus*	--
tree swallow	*Tachycineta bicolor*	--
bank swallow	*Riparia riparia*	--
cliff swallow	*Hirundo pyrrhonota*	--
barn swallow	*Hirundo rustica*	--
gray jay	*Perisoreus canadensis*	--
blue jay	*Cyanocitta cristata*	--
black-billed magpie	*Pica pica*	--
American crow	*Corvus brachyrhynchos*	--
black-capped chickadee	*Parus atricapillus*	--
boreal chickadee	*Parus hudsonicus*	--
red-breasted nuthatch	*Sitta canadensis*	--
house wren	*Troglodytes aedon*	--
ruby-crowned kinglet	*Regulus calendula*	--
Swainson's thrush	*Catharus ustulatus*	--
hermit thrush	*Catharus guttatus*	--
American robin	*Turdus migratorius*	--
bohemian waxwing	*Bombycilla garrulus*	--
cedar waxwing	*Bombycilla cedrorum*	--
Eurpean starling	*Sturnus vulgaris*	--
warbling vireo	*Vireo gilvus*	--
yellow warbler	*Dendroica petechia*	--
yellow-rumped warbler	*Dendroica coronata*	--
American redstart	*Setophaga ruticilla*	--

common yellowthroat	*Geothlypis trichas*	--
western tanager	*Piranga ludovicianus*	*Yellow B-listed in Alberta*
rose-breasted grosbeak	*Pheuticus ludovicianus*	--
chipping sparrow	*Spizella passerina*	--
clay-coloured sparrow	*Spizella pallida*	*Yellow A-listed in Alberta*
vesper sparrow	*Pooecetes gramineus*	--
song sparrow	*Melospiza melodia*	--
white-throated sparrow	*Zonotrichia albicolis*	--
dark-eyed junco	*Junco hyemalis*	--
red-winged blackbird	*Agelaius phoeniceus*	--
Brewer's blackbird	*Euphagus cyanocephalus*	--
common grackle	*Quiscalus quiscula*	--
brown-headed cowbird	*Molothrus ater*	--
northern oriole	*Icterus galbula*	--
purple finch	*Carpodacus purpureus*	--
FISH		
arctic grayling	*Thymallus arcticus*	--
bull trout	*Salvelinus namaycush*	--
northern pike	*Esox lucius*	--
goldeye	*Hiodon alosoides*	--
longnose dace	*Rhinichthys cotaractae*	--
flathead chub	*Platygobio gracilis*	--
lake chub	*Couesius plumbeus*	--
redside shiner	*Richardsonius balteatus*	--
spottail shiner	*Notropis hudsonius*	--
longnose sucker	*Catostomus catostomus*	--
white sucker	*Catostomus commersoni*	--
largescale sucker	*Catostomus macrocheilus*	--
trout-perch	*Percopsis omicomaycus*	--

brook stickleback	*Culaea inconstans*	--
slimy sculpin	*Cottus cognatus*	--

* Species ranking definitions and criteria included in Section 3.0

APPENDIX 9.

PHOTOGRAPHS OF REPRESENTATIVE FEATURES OF THE SADDLE HILLS STUDY AREA.

Plate 1: The Bad Heart River, originating within the Saddle Hills, is the major water course found within the study area. The valley provides important elk production and winter range while also serving as a movement corridor for many other wildlife species.

Plate 2: Vegetation species diversity along the floodplain and adjacent slopes of the Bad Heart River is high with aspen forest, grassland and upland shrubland communities all dominating. The river also acts as a corridor for weed invasion. Note the abundance of weeds species (i.e. Canada thistle) in the foreground of the above photo.

Plate 3: Aspen/prickly rose-common snowberry/awnless brome-bluejoint community type occurring on fluvial and glaciofluvial materials in the Bad Heart River Valley. The prickly rose-common snowberry/awnless brome-bluejoint phase dominates drier sites while aspen cover increases as moisture availability increases.

Plate 4: Prickly rose-common snowberry/awnless brome-bluejoint community type occurring on fluvial materials. Regenerating tree species, such as the white spruce in the background, are unable to form a canopy due to periodic flooding. This enables gramminoid communities to dominate areas immediately adjacent to major watercourses.

Plate 5: Upland shrub and aspen dominated communities, such as the Aspen-balsam poplar/red-osier dogwood-prickly rose community type, dominate wetter areas adjacent to smaller creeks not suspectable to periodic flooding.

Plate 6: The most abundant community occurring within the study area is the Aspen/prickly rose-low bush cranberry/bluejoint community shown above. This community generally occurs on moderately well drained, undulating, fine-textured morainal deposits.

Plate 7: The northern escarpment represents the most significant elevational change within the study area. It is formed by the southern incline of the local bedrock and marks the northern extremity of the Saddle Hills. This escarpment is used as a movement corridor by numerous wildlife species, particularly elk, moose, and black bear.

Plate 8: Bluejoint/buckbean/beaked sedge community type occurring on course-textured lacustrine materials of Hilltop Lake. This community is commonly found along the shorelines of wetlands and lakes.

Plate 9: The Hilltop Lake recreational site is the only such site found within the study area.

Plate 10. Gently undulating to hummocky topography is the dominant landform found within the study area. Disturbances, such as pipeline right-of-way and cultivation, are widespread on the fringes of the Saddle Hills.

Plate 11. White spruce/bunchberry/feathermoss community type occurring on morainal materials (M1 ecosite). Coniferous stands such as these are uncommon in the the Saddle Hills.

Plate 12. Aspen/Canadian buffaloberry/bunchberry community type occurring on morainal materials. This community is generally found on drier sites and southern aspects.

SADDLE HILLS SIGNIFICANT FEATURES AND AREAS OF DISTURBANCE

SCALE 1:65,000

SIGNIFICANT AREAS

Areas of Significance
1 – Bad Heart River and Tributaries
2 – Kleskun Creek Tributaries
3 – Northern Escarpment
4 – Bear River Tributaries
5 – Saddle (Burnt) River Tributaries
6 – Hilltop Lake

DISTURBANCE TYPE

Areas of Disturbance
C – Cultivated (Improved) Land
P – Pasture (Rangeland)
F – Farmstead
S – Subdivision
G – Gas Plant
R – Recreation Site
U – Unclassified
D – Dugout

BASE MAP FEATURES

Secondary Roads
Major Roads
Gravel Roads/Trails
Railway
Major Rivers & Lakes
Minor Rivers
Township Grid
Section Grid

LINEAR DISTURBANCE FEATURES

Secondary Roads
Major Roads
Gravel Roads/Trails
Railway
Pipe Lines
Well Sites

RANGE 8
RANGE 7
RANGE 6
TOWNSHIP 55

RANGE 4

TOWNSHIP
76

TOWNSHIP
76

RANGE 5

RANGE 3

RANGE 2

TOWNSHIP
75

RANGE 8

RANGE 7

RANGE 6

TOWNSHIP 75

TOWNSHIP 74

RANGE 8

RANGE 7

RANGE 6

RANGE 3

RANGE 2

TOWNSHIP 75

TOWNSHIP 74

RANGE 5

RANGE 4

RANGE 3

RANGE 2

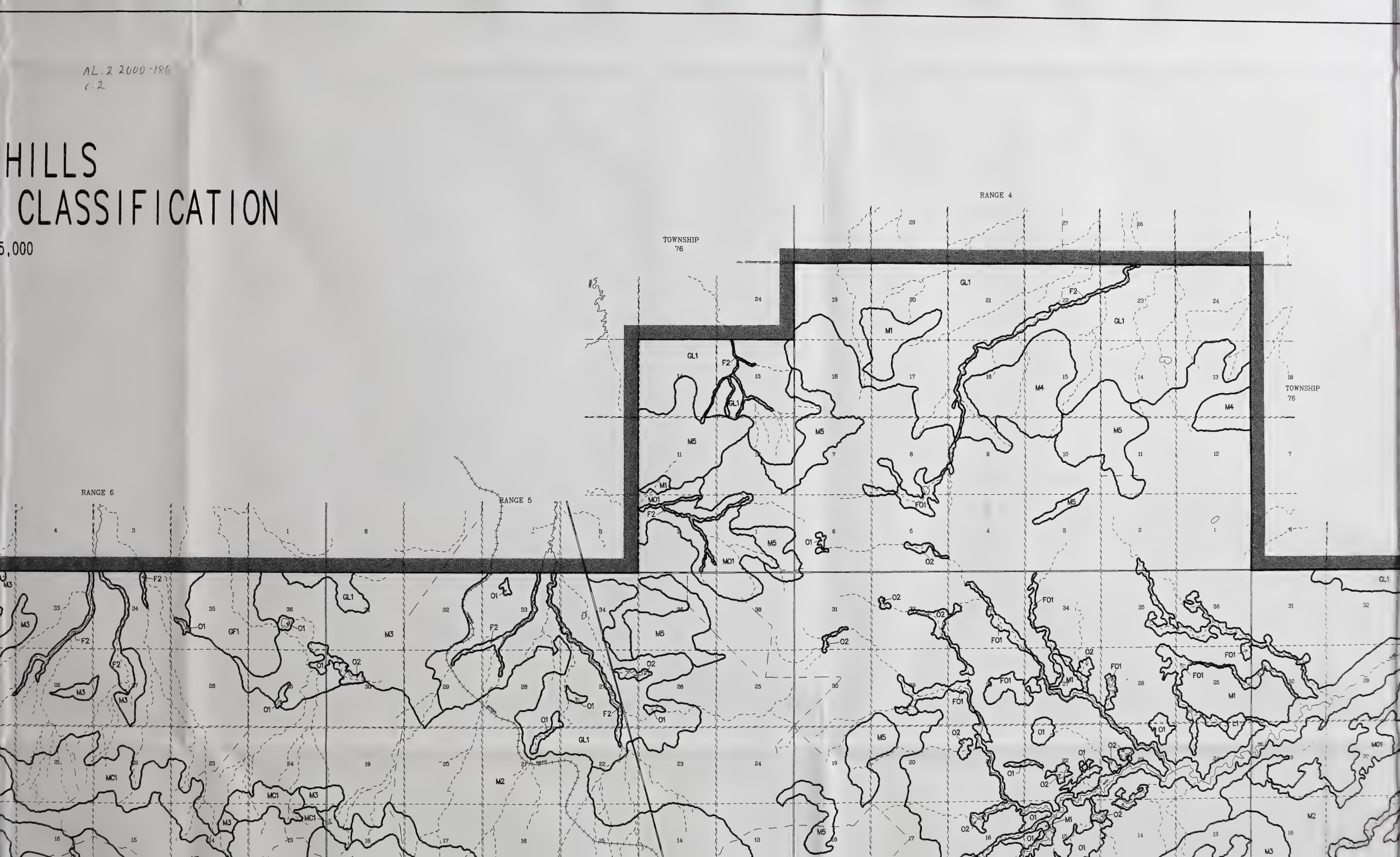
GEOWEST Environmental Consultants Ltd., June [illegible]

SADDLE HILLS
ECOLOGICAL LAND CLASSIFICATION

SCALE 1:65,000

HILLS
CLASSIFICATION

5,000



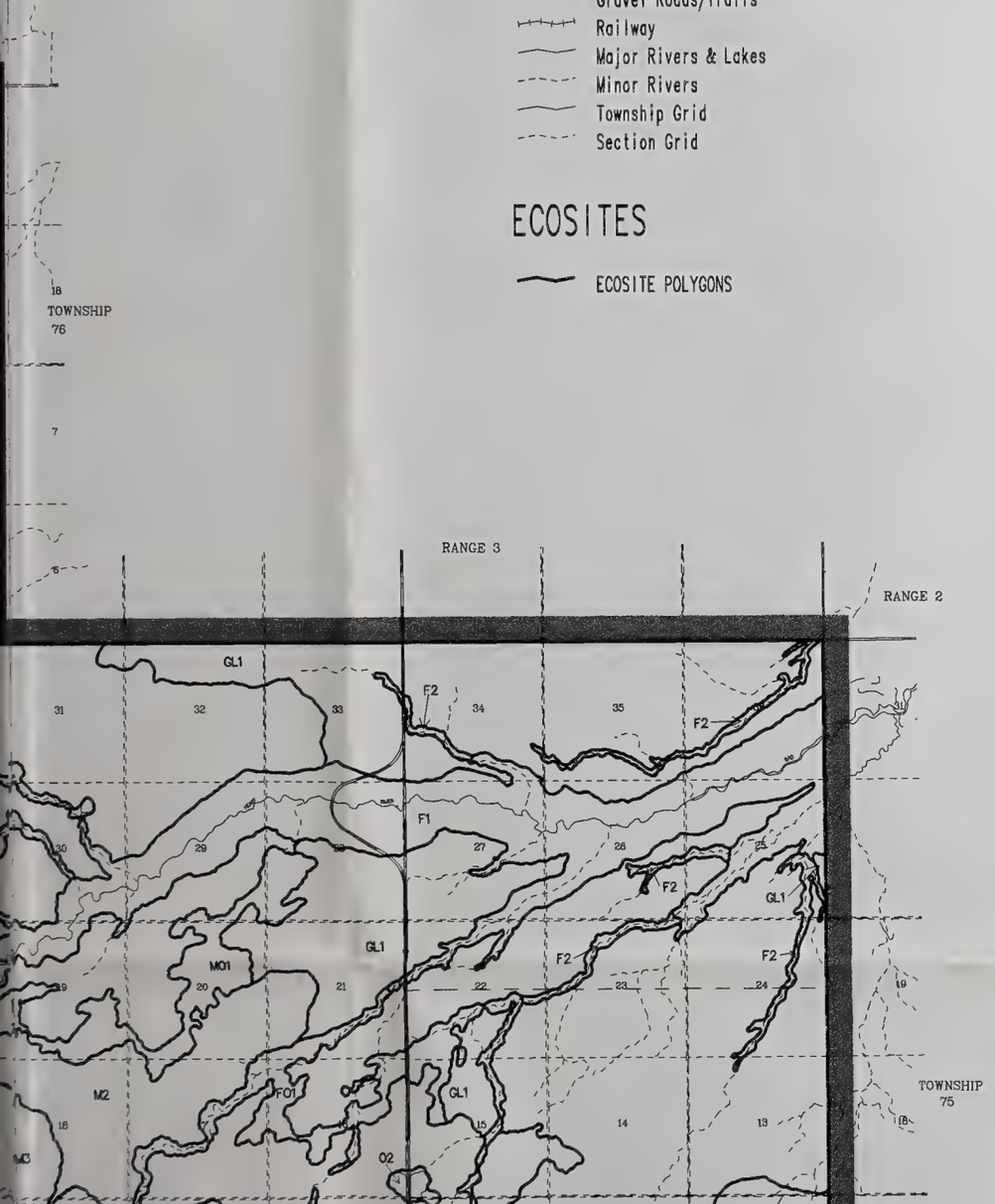
LEGEND

BASE MAP FEATURES

- Major Roads
- Secondary Roads
- Gravel Roads/Trails
- Railway
- Major Rivers & Lakes
- Minor Rivers
- Township Grid
- Section Grid

ECOSITES

- ECOSITE POLYGONS



ECOSITE	LANDFORM AND SURFICIAL MATERIAL	VEGETATION
FLUVIAL		
F1	Incised, V-shaped valley of the Bad Heart River; low to moderate gradient; channel materials consist of alluvial sands, silts and gravels while valley slopes consist of fine textured colluvial and alluvial materials; slumping common	Aspen/prickly rose-snowberry/awnless brome-bluejoint; Aspen-balsam poplar/red-osier dogwood-prickly rose; prickly rose-snowberry/awnless brome-bluejoint
F2	Low gradient, small permanent and intermittent streams; fine textured slightly stony alluvial materials; generally low banks	Prickly rose-snowberry/awnless brome-bluejoint; Aspen-balsam poplar/red-osier dogwood-prickly rose
FLUVIAL AND ORGANIC		
FO1	Small permanent and intermittent streams with broad organic floodplains; subsurface drainage common; alluvium and shallow organic materials	Aspen/prickly rose-low-bush cranberry/bluejoint; Black spruce-tamarack/common Labrador tea/sphagnum moss; Sedge fen; Bog birch-willow/sedge/moss
GLACIOFLUVIAL		
GF1	Gently sloping meltwater channels; discontinuous glaciofluvial veneers and blankets over moraine	Aspen/prickly rose-low-bush cranberry/wild sarsaparilla
GLACIOLACUSTRINE		
GL1	Discontinuous undulating to inclined fine textured glaciolacustrine veneers and blankets overlying fine textured, undulating morainal deposits; non-stony veneers and blankets over slightly stony till	Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; Aspen balsam poplar/red-osier dogwood-prickly rose; Aspen/prickly rose-low-bush cranberry/bluejoint
LACUSTRINE		
L1	Level to gently undulating lacustrine deposits with inclusions of remnant or active beach deposits overlying morainal materials; generally non-stony	Bluejoint-beaked sedge/buck-bean; Cattail-sedge
MORAINE AND GLACIOLACUSTRINE		
MGL1	Discontinuous medium textured glaciolacustrine beach deposits occurring with undulating morainal blankets	Aspen-balsam poplar/green alder/bluejoint
MORAINE		
M1	Undulating and gentiy sloping to level morainal deposits; fine textured; slightly stony, often with thin non-stony loamy veneers	Aspen/prickly rose-snowberry/awnless brome; Aspen/prickly rose-low-bush cranberry/bluejoint; Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; Aspen-balsam poplar/red-osier dogwood-prickly rose; Aspen-balsam poplar/green alder/bluejoint; Aspen/Canada buffaloberry/bunchberry; White spruce/bunchberry/feathermoss
M2	Undulating and gently sloping to level morainal deposits; fine textured and very stony	Aspen/prickly rose-snowberry/awnless brome/bluejoint; Aspen/prickly rose-low-bush cranberry/bluejoint; Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; Aspen-balsam poplar/red-osier dogwood-prickly rose; Aspen-balsam poplar/green alder/bluejoint; Aspen/Canada buffaloberry/bunchberry; White spruce/bunchberry/feathermoss; Lodgepole pine/green alder/bunchberry; Lodgepole pine-white spruce/common Labrador tea/feathermoss
M3	Moderately to steeply inclined and rolling morainal deposits; fine textured and very stony	Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; Aspen-balsam poplar/green alder/bluejoint; Aspen/prickly rose-low-bush cranberry/bluejoint
M4	Undulating, rolling and inclined morainal deposits with discontinuous areas of morainal veneers over sandstone bedrock; medium to coarse textured; non to very stony	Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; aspen/prickly rose-low-bush cranberry/bluejoint; Aspen/Canada buffaloberry/bunchberry
M5	Moderately to steeply inclined and rolling morainal	Aspen/prickly rose-low-bush cranberry

RANGE 8

RANGE 7

RANGE 6

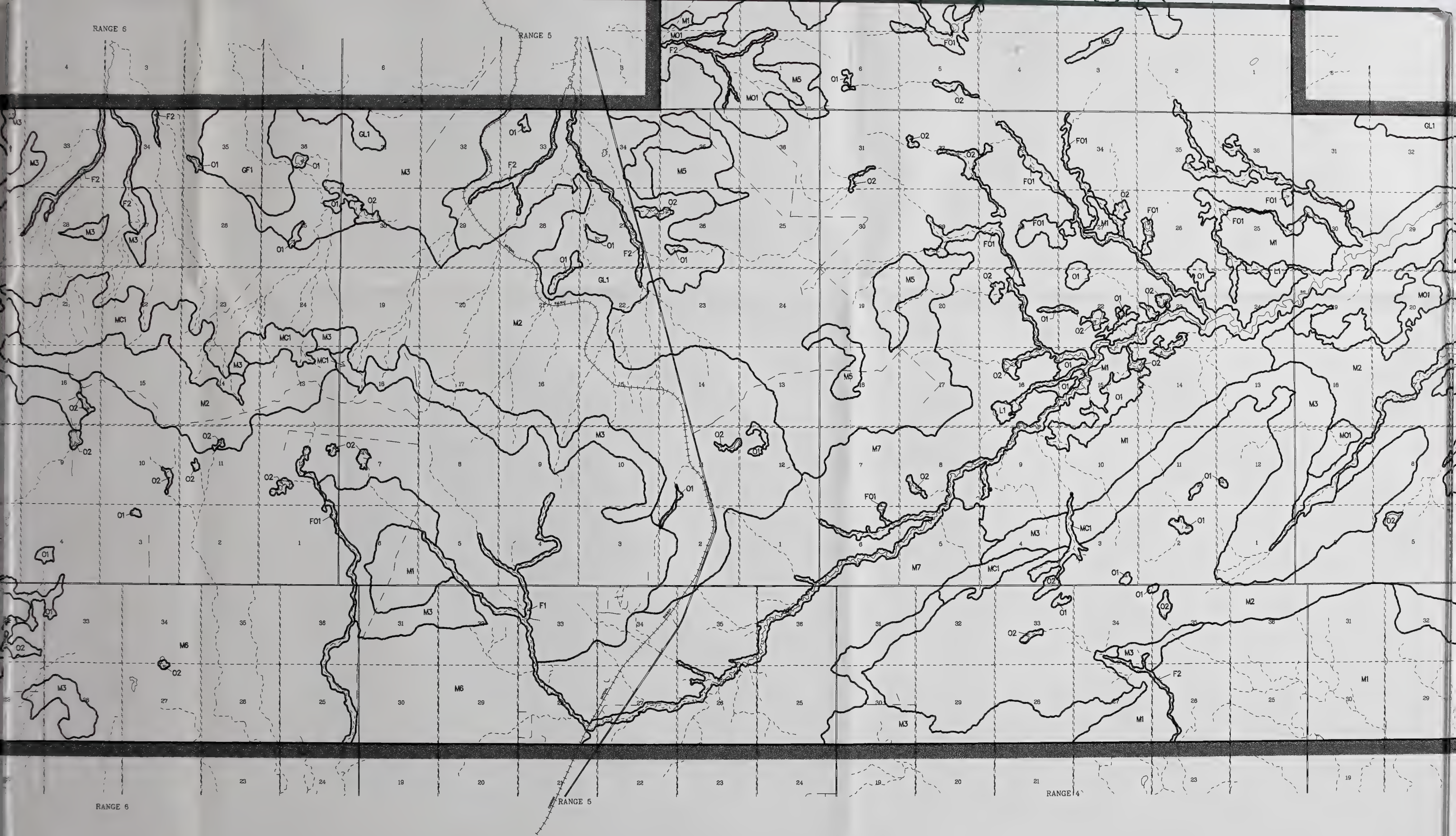
TOWNSHIP 75

TOWNSHIP 74

RANGE 8

RANGE 7

RANGE 6


RANGE 6
RANGE 5
RANGE 4
M1
MO1
F2
M5
FO1
O2
O1
GL1
GF1
M3
F2
M2
MC1
L1
M7
F1
M6
MO1
RANGE 6
RANGE 5
RANGE 4

	glaciofluvial veneers and blankets over moraine	wild sarsaparilla
GLACIOLACUSTRINE		
GL1	Discontinuous undulating to inclined fine textured glaciolacustrine veneers and blankets overlying fine textured, undulating morainal deposits; non-stony veneers and blankets over slightly stony till	Aspen/prickly rose-low-bush cranberry/ wild sarsaparilla; Aspen balsam poplar/ red-osier dogwood-prickly rose; Aspen/ prickly rose-low-bush cranberry/bluejoint
LACUSTRINE		
L1	Level to gently undulating lacustrine deposits with inclusions of remnant or active beach deposits overlying morainal materials; generally non-stony	Bluejoint-beaked sedge/buck-bean; Cattail-sedge
MORAINE AND GLACIOLACUSTRINE		
MGL1	Discontinuous medium textured glaciolacustrine beach deposits occurring with undulating morainal blankets	Aspen-balsam poplar/green alder/bluejoint
MORAINE		
M1	Undulating and gently sloping to level morainal deposits; fine textured; slightly stony, often with thin non-stony loamy veneers	Aspen/prickly rose-snowberry/awnless brome; Aspen/prickly rose-low-bush cranberry/ bluejoint; Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; Aspen-balsam poplar/red-osier dogwood-prickly rose; Aspen-balsam poplar/green alder/ bluejoint; Aspen/Canada buffaloberry/ bunchberry; White spruce/bunchberry/ feathermoss
M2	Undulating and gently sloping to level morainal deposits; fine textured and very stony	Aspen/prickly rose-snowberry/awnless brome/ bluejoint; Aspen/prickly rose-low-bush cranberry/bluejoint; Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; Aspen-balsam poplar/red-osier dogwood-prickly rose; Aspen-balsam poplar/green alder/bluejoint; Aspen/Canada buffaloberry/ bunchberry; White spruce/bunchberry/ feathermoss; Lodgepole pine/green alder/ bunchberry; Lodgepole pine-white spruce/ common Labrador tea/feathermoss
M3	Moderately to steeply inclined and rolling morainal deposits; fine textured and very stony	Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; Aspen-balsam poplar/green alder/bluejoint; Aspen/prickly rose-low-bush cranberry/bluejoint
M4	Undulating, rolling and inclined morainal deposits with discontinuous areas of morainal veneers over sandstone bedrock; medium to coarse textured; non to very stony	Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; aspen/prickly rose-low-bush cranberry/bluejoint; Aspen/Canada buffaloberry/bunchberry
M5	Moderately to steeply inclined and rolling morainal deposits; fine textured and slightly stony; often with thin non-stony loamy veneers	Aspen/prickly rose-low-bush cranberry /wild sarsaparilla; Aspen-balsam poplar /green alder/bluejoint;Aspen/prickly rose-low-bush cranberry/bluejoint; White spruce/bunchberry/feathermoss
M6	Undulating to hummocky morainal deposits; fine-textured and very stony	Aspen/prickly rose-low-bush cranberry /bluejoint; Aspen-balsam poplar/ green alder/bluejoint; Aspen/Canada buffaloberry/bunchberry; Lodgepole pine/green alder/bunchberry
M7	Gently sloping morainal deposits; fine textured and slightly stony	Aspen/prickly rose-low-bush cranberry/bluejoint; White spruce/bunchberry/feathermoss
MORAINE AND COLLUVIUM		
MC1	Colluvial veneers and blankets overlaying moderately to steeply inclined and rolling morainal deposits	Aspen/prickly rose-low-bush cranberry/ wild sarsaparilla; Aspen/prickly rose-low -bush cranberry/bluejoint; Willow-alder shrubland
MORAINE AND ORGANIC		
MO1	Low undulating and gently rolling morainal deposits interspersed with depressional organic deposits in interknoll sites	Lodgepole pine-white spruce/common Labrador tea/feathermoss; Black spruce -tamarack/common Labrador tea/Sphagnum spp.;Aspen/prickly rose-low-bush cranberry/wild sarsaparilla; Aspen/ prickly rose-low-bush cranberry/bluejoint
ORGANIC		
O1	Depressional generally shallow organic deposits; primarily moss peat material	Black spruce-tamarack/common Labrador tea/ Sphagnum ssp.; Bog birch-willow/sedge/moss
O2	Level organic (marsh) deposits bordering open water; floating organic mats and emergent aquatic vegetation common; primarily sedge peat; permanent surface water common	Sedge fen; Cattail-sedge

GEOWEST Environmental Consultants Ltd. , June 1999

SADDLE HILLS SENSITIVE AREAS

SCALE 1:65,000

SENSITIVITY RATING

- HIGH SENSITIVITY
- MODERATE SENSITIVITY
- LOW SENSITIVITY

BASE MAP FEATURES

- Major Roads
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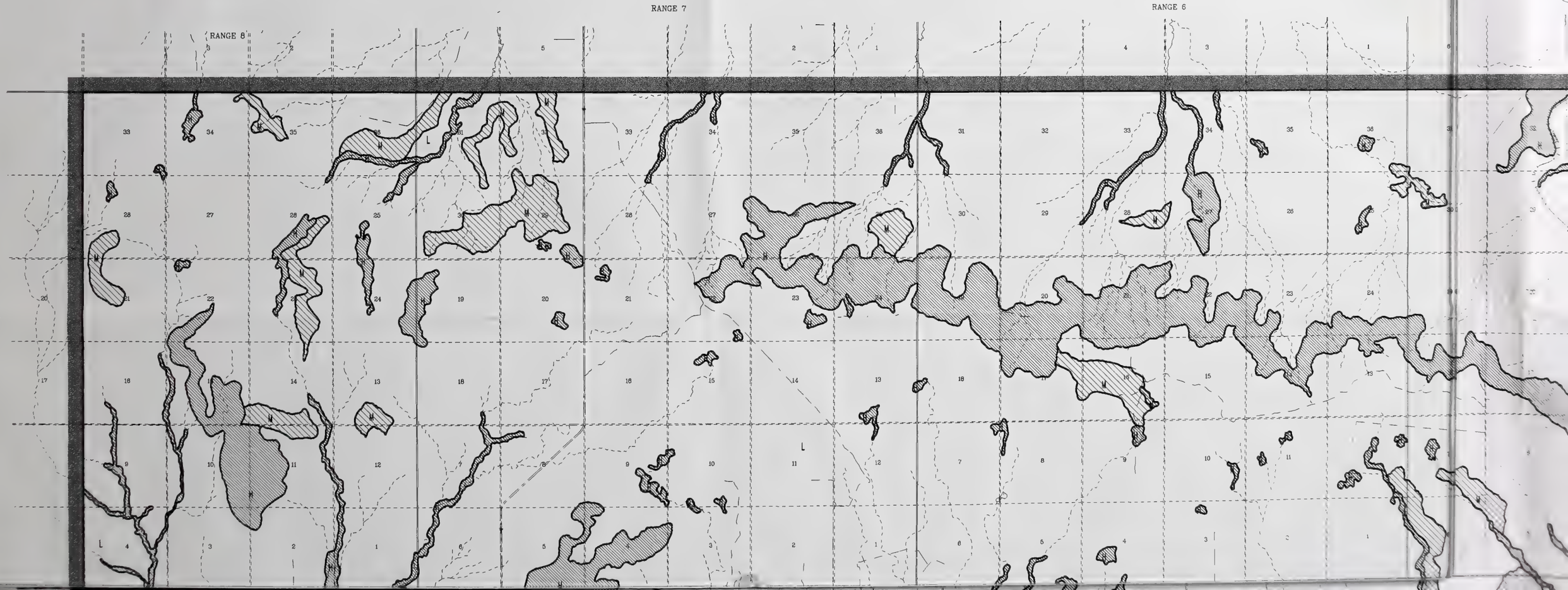


RANGE 8
RANGE 7
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TOWNSHIP 74
RANGE 8
RANGE 7
RANGE 6

RANGE 4

TOWNSHIP 76

TOWNSHIP 76

RANGE 5

RANGE 3

RANGE 2

TOWNSHIP 75

TOWNSHIP 74

RANGE 5

RANGE 4

RANGE 3

RANGE 2